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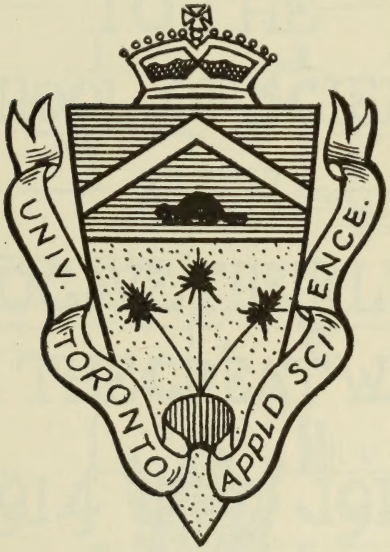
No. 35 1921-22

The Transactions

of

The University of Toronto Engineering Society

With which is incorporated the **Applied Science**



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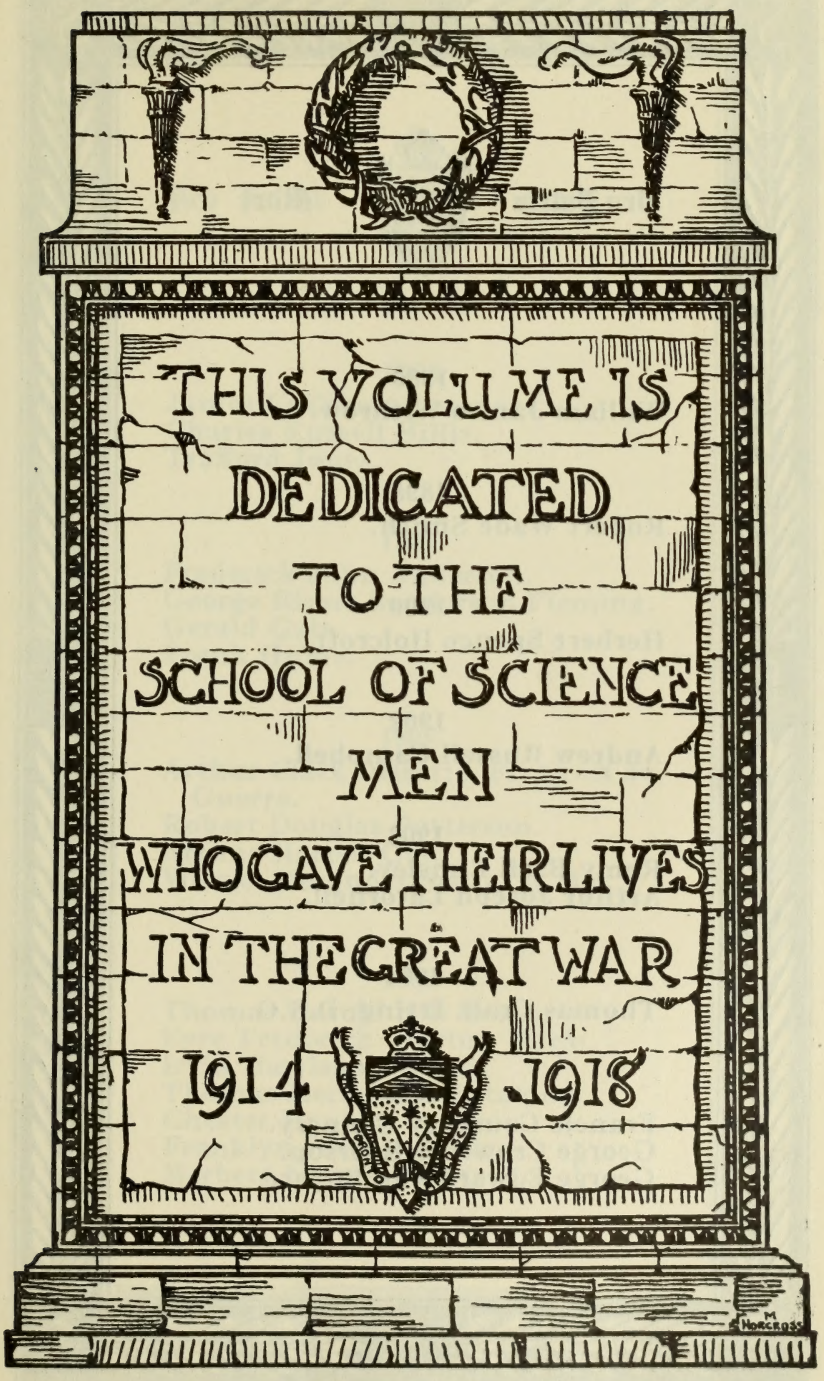
THIS VOLUME IS
DEDICATED
TO THE
SCHOOL OF SCIENCE
MEN
WHO GAVE THEIR LIVES
IN THE GREAT WAR
1914 1918

Pro Patria Mori

1890
William James Withrow.

1898
Robert Wade Smith.

1900
Herbert Spence Holcroft.

1902
Andrew Russell Campbell.

1903
Remy Basil Elmsley.
Arthur Joseph Latornell.

1904
Thomas Craik Irving, D.S.O.

1905
Francis Courtney Connery.
George Crowther Ryerson.
George Edward Van Sittart.

Pro Patria Mori

1906

James Cuthbert Hartney.
Charles Russell Hillis.
Trafford Jones.

1907

Frederick John Anderson.
George Rivers Sanderson Fleming.
Gerald Galt.
Frank Hume.

1908

Arthur Clark Dissette, Fr. Croix de Guerre.
Robert Douglas Patterson.
Arthur Harper Qua.
Walter Alexander Scott, M.M.

1909

Thomas Harold Hill Bevan.
Eyre Frederick Morton Danu.
Irvin Harrison Dawson.
Thomas Herman Heintzman.
Chester Hughes.
Franklyn Palmer Jackes.
Herbert Norman Klotz.

Pro Patria Mori

1910

William George Amsden.
William MacKay Carlyle.
Arthur Willoughby Chestnut.
Joseph Grant Halliwell.
Alexander Gilmour Macdonald.
George Gordon Maclennan, Fr. Croix de Guerre.
Frank Raymer Mortimer.
David Edgan Pye.
Joseph Tackaberry Walker.
James Leroy Whitside.

1911

Walter Osler Boswell.
Harry William Frogley.
Norman John Harvie.
Ralph Himsworth Jarvis, M.C., Belgian Croix de Guerre.
Norman Lawless.
Robert Edward Macbeth.
Russell Hugh MacDougall.
Dougald Black Maclean.
David Douglas Macleod.
Stanley James Pepler.
William Newton Read.
Ellis Vair Reid, D.S.C.
William Stanley Steele.
William Gordon Tough.
Kenneth Marsden Van Allen.

Pro Patria Mori

George Thomas Newell Vicars.
George Knox Williams.

1913

Arthur Stewart Anderson.
Bruce Hosmer Acton Burrows.
Oliver Lorne Cameron.
Albert Edward Cuzner.
John Turner Howard.
Hugh D'Alton Livingstone.
Henry James Quail.
Russell Wright Soper.
Jeffrey McVicar Strathy.
Geoffrey Barron Taylor.
Robert Edward Watts.

1914

Eric Montague Abendana.
Frederick Charles Andrews.
Percy Vere Binns.
Walter James Brooks.
Charles Butler.
John James Campbell, M.C.
William Willis Code.
Charles Penner Cotton.
Shirley Duncan Ellis, M.C.
James Stephenson Fleming.
John Kay, M.C.
Sidney Albert Lang.

Pro Patria Mori

Charles Kenneth MacPherson.
Cecil Victor Perry, M.C.
Paul Raney.
James Garnet Scott.
Joseph Gore Shepley.
John Sandford Taylor.
Elfric Ashby Twidale.
Hugh Douglas MacIntosh Wallace.
Wilfred John Watts.
Arthur Warren Youell, M.C.

1915

George Gilbert Bricker.
Warren George Brown.
James Pomeroy Cavers.
Gordon Allen Cockburn.
James Drew Cook.
Gordon Parsons Davidson.
Robert Douglas Galbraith, M.C.
Grant Armstrong Gooderham.
Walter Harvey Russell Gould.
William Teasdale Hall.
Harold Oakley Leach, M.C.
William Eric Lockhart.
Basil Menzies Morris.
John Anthony Ninian Ormsby.
Henry Martyn Peck.
Valentine Ralph Pfrimmer.
William Emsley Raley.
Russell George Scott.

Pro Patria Mori

Wesley George Shier, D.C.M.
Robert Blackburn Sinclair.
John Howard Stewart.
George Stacey Stratford.
Charles Herbert Wheelock.
Jack Northmore Williams.

1916

James Ronald Chapman.
John Wilbur Crane.
Russell Andrew Cross.
James Nelson Cunningham.
Hugh Alexander MacKay Grassett.
Daniel Galer Hagarty.
John Richmond Kirby.
John Carr Newcombe.
Harry Reed Nicholson.
Clifford Ellis Rogers.
Ayscean Francis Robert Wm. Swinnerton.
Merrill Samuel Taylor, French Croix de Guerre.
Robert Edward Taylor.

1917

William Harvey Aggett.
Wilfred Bissell Andrew.
Wilfred Robert Bauer.
William Allen Bishop.

Pro Patria Mori

Frazer MacPherson Bryans.
Frederick Lawrence Eardley-Wilmot.
Franklyn Reginald Gibson.
Charles Edward Harrop.
Roy Richard Hawkey.
Arthur Gerald Knight, M.C., D.S.O.
Harold Lamont Longworthy.
George Arthur McEwen.
John Edward Sharman, D.S.C. and Bar, French Cruix de Guerre, avec Palme.
George Alfred Whately.

1918

William Gordon Brown.
Oswald Gilbert Darling.
Lester Jerome Deacon.
Thomas Wilfrid Duncan.
James Alexander Garvie, M.C.
Ralph Vivian Gordon.
Thomas Leslie Harling.
Thomas Barclay Jack.
Peter Lydell McGavin.
Gordon King MacKendrick.
John Roy Mitchener.
Armine Frank Gibson Norris, M.C.

Pro Patria Mori

Gordon Mackenzie Pearce.
Horace Pearson.
Thomas William Penhale.
David Alexander Robinson.
Malcolm Douglas Schell, D.C.M.
Douglas Gordon Scott.
James Mitchell Souter.
Chester Matthew Willey.
Philip Edward Williams.
Frank Abbott Wood.
Norman Clark Wood, M.C.

1919

John Lawrence Cleary.
Harry Lawrence Crow.
Russell Thomas Gardner.
Clifford Robinson Hames.
Donald Gordon Maclean.
John Reginald Maguire.
Charles Albert Von Holt Michell.
Stanley Wallace Rosevear, D.S.C. and bar.
Henry Glassford Ward.

1920

Roy Andrew Hartrey, M.M.
Edward Basil Gowan Morton.

Forward

The Engineering Society has passed through another successful year and it is now firmly re-established and revived after the War. The President and Executive Committee are to be congratulated upon the general success of the Society which is now in a flourishing condition.

.The business programme for the year appears to have been well conceived and very successfully carried out The several sections of the Society too appear to have had a successful year.

During the past year you have had a most useful and interesting series of addresses and papers on technical subjects which will prove of very considerable value not only to the graduates and members of the profession but to you yourselves as you are about to enter the active work of the profession. These addresses are now being put into your annual publication known as the Transactions of the Engineering Society and in this manner will be preserved for further use.

The present volume of the Engineering Society's Transactions will have a peculiar interest in a manner which will be distinctive this year and which will mark it as one carrying memories of the Great War in a manner peculiarly its own. When you started your session it was announced that you wished to keep particularly in mind the memory of those comrades who fell in the War, and this thought has been uppermost throughout the session as the Engineering Society has carried out its programme. This volume of Transactions is therefore dedicated to the memory of those splendid comrades who gave their lives and whose memory will always be preserved, not only by the Graduating Year, but by the Years preceding and following it. It occurs to me personally, and I am sure the same thought occurs to many members of the Staff of this Faculty, a great regret that as these post-war years go by the number of undergraduates who have seen service in the War is rapidly diminishing, and with the departure of this present graduating year there will leave these halls a large number of ex-soldiers who carry with them a wealth of memory which they will always have for their portion in the years to come. It is this memory which all of us who have been at the War retain and look upon as a possession of great value. It is the memory, however, of the splendid lives and achievements of our comrades whom we left behind in Flanders' Fields and whose example we will always remember, that will be our most cherished possession. As this book goes out to find its place amongst the graduates and the profession, it goes carrying with it this memory and this deep admiration which we had for those comrades who gave their lives so that we and Canada and the Empire might come through.

I heartily wish the President, the Officers and the Members of the Engineering Society all success and good fortune in now closing the present session, and I wish also to thank them for their hearty co-operation in connection with student matters generally with regard to the affairs of the Faculty.

March, 1922. C. H. MITCHELL, Dean.

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THE TRANSACTIONS of the University of Toronto Engineering Society

WITH WHICH IS INCORPORATED THE "APPLIED SCIENCE"

No. 35 TORONTO, APRIL 15, 1922 1921-22

PROVINCIAL HIGHWAYS.*

By Geo. Hogarth, '09, Chief Engineer of Highways, Department of Public Works of Ontario.

ONTARIO has a system of Provincial Highways 1,812 miles in length which joins every city in the southern portion of the Province. These roads threading through the counties of older Ontario, serve as main routes of travel between distant points and at the same time are of benefit to local districts points and at the same time are of benefit to local districts market centres.

Roads in Ontario are supervised by various authorities and in order to give a clear view of the position of the Provincial Highways in the road development programme a short description of the different kinds of roads is necessary.

In the original surveys of townships, road allowances were left as concession lines, or side lines, around blocks of land, and the township council has authority over such roads which it builds and maintains, the province to aid the townships with the work grants a bonus of 20% of the cost of the work.

Throughout the counties there are many roads which serve as main market roads to towns, cities, and shipping points. Such roads are of more importance to the community than the township road, require better construction, greater width and stronger surface, and the counties have, therefore, been authorized to assume and construct a system of county roads. Usually about 15% of the road mileage in the county is taken as county roads and towards the cost the Government contributes 40% of the cost of construction and maintenance. Should some of the roads taken as county roads be important thoroughfares leading to towns and cities, or main routes through a county, they may be designated Provincial County Roads, in which case the Government contributes 60% of the cost of construction and maintenance.

*Address delivered before the Civil Club on Wednesday, Nov. 3rd, 1921.

In the immediate vicinity of cities all main roads require special attention to resist the heavy traffic and in the case of county roads for a distance from the city, a commission may be appointed by the county and the city to have charge of and build such main highways. The highways assumed are known as County Suburban Roads and are paid for, 30% by the city and county, and 40% by the Government. Very important suburban roads bay be designated Provincial Counyt Suburban Roads, in which case the city and county each pay 20% and the Government 60% of the cost of the work.

On provincial highways 80% of the cost of the work, together with all overhead charges and land required, is paid by the Government, and 20% by the county in which the road is situated. In the vicinity of cities, a certain mileage of provincial highways may be designated Provincial Suburban, in which case the city and county each pay 20% of the cost, and the Government 60%. Provincial highways are not designated entirely through towns but only extend into the municipality where the road is in front of farm lands. Where the continuation of a provincial highway passes through the business section of a town, the Government pays 40% of the cost of the central 20 feet of pavement laid by the town on the business street.

It will be readily seen that with the above system in operation, those roads requiring attention because of heavy and important traffic are so provided for that every facility for proper construction and maintenance is given.

The provincial county suburban roads, provincial suburban and provincial highways are all built to a high standard, with paved widths of 18 or 20 feet, with a full top width of road of 30 feet, and with adequate and effective drainage to protect the investment in surface. In addition, the provincial highway cross section provides a space for sidewalks on each side of the road, proper space for public services, such as rural free delivery post boxes, telephone, telegraph and power poles, also a location for underground services, water and gas.

The roadway portion of provincial highways is surfaced with material suitable for the traffic passing over it. Should the traffic be medium, a gravel road well drained and maintained, gives an economical surface, while for heavier traffic oiled macadam or penetration surfaces or pavements, such as asphaltic concrete or cement concrete, are provided. Because of the fact that the heaviest of traffic is found just outside cities, it has been found necessary in many cases to construct pavements as fast as ruling conditions permit, while on sections remote from cities, ditching operations, gravelling of long stretches and the bringing of the entire system up to a uniform standard are carefully attended to. In the year 1921, the Department of Public Highways graded 70 miles of road, gravelled 120 miles, placed macadam base on 33

miles, constructed finished macadam on 40 miles, bituminous macadam 17 miles, asphaltic concrete on 20½ miles, and cement concrete 25 miles, besides building 1,200 culverts and bridges.

To properly build a gravel road requires a dry roadway surface which in practically any location can be obtained by digging a ditch on each side of the travelled way. After the earth has been properly levelled and trimmed, a light coating of gravel about four inches in depth and 8 to 10 feet wide can be rapidly spread. This first layer should be carefully levelled and all stones raked ahead so as to be buried under succeeding loads of gravel. While gravelling progresses, the surface of portions completed should be kept smooth by means of the log drag, so that as the material is compacted it will be smooth for traffic. After the first layer of gravel has been consolidated in place, subsequent layers may be added as required, but in all cases care should be taken to see that the gravel is spread thinly to a depth of not more than two inches. Such a depth, properly spread and dragged and applied, if needed, spring and fall, will give excellent results. Gravel roads are readily built because over a large portion of Southern Ontario good road building gravel can

Concrete Pavement Between London and Lambeth.

be obtained on or close to the road and the cheapest of road building methods, intelligently applied, will give untold satisfaction.

Macadam roads, being built of crushed stone, are usually desirable where traffic is heavy and where field stone or quarry stone can be easily obtained. In sections of the county where bed

rock does not exist, field stone may be gathered into piles convenient for crushing, and portable crushers used to crack the stone to proper size.

In localities well served by railways and having commercial crushed stone available at reasonable rates, such material can be used to construct a two-course macadam, having large stone of about four-inch size in the base course, and two-inch stone in the top course. The lower course is usually five or six inches thick after compression and the top course four inches thick after compression. Surfaces of macadam roads are built with a crown of one-quarter to three-eighths inch per foot so as to give sufficient drainage.

Bituminous macadam surface consists of a depth of two-inch stone about three and one-half inches in thickness, into which hot tar or asphalt is forced under pressure. The stone is carefully levelled and may be given a light rolling before penetrating. If tar is used, it is heated to about 250° F. and if asphalt, to about 350° F. In the first application, about 1½ gallons of bitumen per square yard is used, and while the material is still hot and soft, stone chips are spread rapidly over the road surface. The roller is then passed over, a second light coat of bitumen applied at a rate of about one-half gallon per square yard, then a light coat of stone chips applied and, after a thorough rolling, the roadway may be opened to traffic.

Asphaltic concrete surface is laid in two courses each 1½ inches thick, on either a good macadam or concrete foundation. The lower course of the mix uses sand and coarse stone up to about half an inch in size, while the top course may contain only a well graded sand. The upper or lower course is mixed separately in an asphaltic mixing plant and about 11% of asphalt is sufficient to give good results. Such pavements will carry the heaviest of traffic and give service over a period of years.

Concrete pavements may be constructed of cement, sand and good gravel or crushed stone in the proportions of 1 part of cement to 1½ parts sand to 3 parts gravel or stone. The thickness at the sides is usually six inches and eight and one-half inches in the centre.

Transverse expansion joints may be left every 50 feet and in some cases a longitudinal centre joint may be desirable. Good results under heavy service conditions may be confidently expected from any well laid concrete pavement.

Structures on provincial highways are built to carry Class C loading, the concentrated load of which is a 20-ton road roller. Spans of from 2 to 20 feet are built of concrete with flat slab reinforced top. Longer spans are steel girders or trusses. The clear width of roadway is 24 feet, or greater if special conditions demand, and if the bridge is in or near a large centre, one or more sidewalks 6 feet in clear width are provided. All culverts are

built of such a length that the full 30 feet of top width of road can be placed between the end walls.

Where excessive grading is not required, the maximum grade on the provincial highways is 5%, but in exceptional cases this may be increased to 7%, which is as steep as any highway grade can safely be.

Every effort is being put forward to make the highways attractive by tree planting and attention to the roadside so that people will be drawn to the main roads and tourist traffic be encouraged as it is one source of revenue needing development.

The highways entering the cities are being attended to immediately and surfaces completed so as to serve those portions of the system which have the heaviest of traffic. To finish such pavements requires, in many cases, bridges, and new locations for main roads to give direct access to large arteries of travel in the cities.

The highways now completed are giving efficient service to sections of the country which urgently required rapid transportation, and as fast as public opinion and finances permit the benefits of such construction are being given to an ever widening area of the Province of Ontario.

ENGINEERING AND TRADE WITHIN THE EMPIRE.*

By Brig.-Gen. C. H. Mitchell.

LAST year at the opening meeting of the Engineering Society I spoke on engineering activities in Canada. To-day I felt that there was rather a new phase that would be interesting. I want quickly to run over the engineering activities in Canada and then to go farther afield and consider the Empire and our relation to it.

Canada has come through a long period of development. Sir Robert Borden, speaking here lately, traced out the development of autonomous government in Canada from the beginning of British rule. In getting as far as we have, we must remember that although autonomous, we are still in the Empire and must think of Canada as part of the Empire.

Applying that idea to engineering, Canada was at first entirely dependent upon other countries for engineering products and developments. At the beginning of the war we were at the peak of ordinary development. The war developed us in a different direction. We must take up peaceful development again and make use of our abnormal war development for that purpose.

*The Dean's opening address to the Engineering Society, October 26th, 1921.

During the past fifty years the pendulum has swung many times. It is now swinging towards the Empire again and we are entering a period of great commercial activities with the Old Country. During the Summer a congress of the universities of the Empire was held in England. This gave me the idea that Canada has a very large part to play in co-operation between students and teachers throughout the Empire. An Empire policy has been evolved in England by Lloyd George which provides for the continuance of that co-operation within the Empire which proved so effective during the war, in order to promote Empire trade.

Engineering Activities in Canada.

I shall now briefly outline the activities in Canada at the present time in engineering fields. The first function of this country is agriculture—the production of food, and in that respect the engineer is second to the farmer. But farm produce must be transported and here at once the engineer comes in. There is not much work going on in the building of transportation lines at present, but much preparatory work is being done, e.g., docks, harbours, canals, terminals, etc. The whole question of transportation is very much in the air at the present time. The annual deficit of the railways taken over by the government is one of the greatest problems this country will have to face in the near future.

Highway construction is being carried out on a large scale in all the older provinces.

We are all familiar with the power developments going on around us, but we must not think that all the development is taking place in Ontario. Power development plants are under construction in Nova Scotia near Halifax, in New Brunswick near St. John, in Quebec, in Manitoba near Winnipeg, and two large plants in British Columbia.

Municipalities have gone and are still going through a period of difficult financing. There is very considerable activity, however, in the various phases of municipal engineering, such as water works, sewers, town planning, sidewalks, sanitary works, drainage, lighting, bridges, etc.

There seems to be a depression in the building trade at the present time, but there is some activity throughout the country, notably in Toronto, in Montreal and vicinity and in the Maritime Provinces. Very few large buildings are under construction.

Mining activities are still suffering from the depression following the war, but there are bound to be great developments, especially in those fields where prospecting was going on before the war and has now been resumed, e.g., northern Ontario, British Columbia, Labrador, northern Saskatchewan.

Considering the industrial world we find less employment than at this time last year; but we should not be discouraged, as a gradual improvement may be expected. Iron and steel, grain milling, wood products, cement, lime, clay, ceramics, brick, tile, are basic industries which must go on and will always provide work for engineers. Less basic industries are quiet, but showing signs of improvement. There is great mechanical activity in the manufacture of thousands of articles and also in the manufacture of electrical appliances.

If one considers the great variety of materials used, for example, in the new electrical building, one can realize the varied activity in the country in the line of building supplies.

The automobile industry has been overdone and there is a slump at present due to over production and lack of business.

The paper industry reached the top notch at the end of the war; there is a slump at present and prices are lower, but some construction is going on. The same remarks apply to the sugar refining industry. Business is very large, but as in the case of many other industries, it is suffering from losses on materials bought at war prices and sold at post war prices. Cane sugar is imported from the West Indies and the Orient and refined on both coasts. The business of equipping these refineries is going to form a large industry in Canada.

The oil business has received a big impetus from the discoveries in the MacKenzie and Peace River valleys. These may mean much in the next few years when a huge demand is going to arise for transportation purposes to replace coal.

In the field of chemical industry, in addition to all the industries already mentioned which may be classed in this way, we have the large munition plants at Trenton, Parry Sound and Weston now engaged in peace production. This shows the power of adaptation of the country and of its engineers and chemists.

Empire Trade Relations.

In nearly all the industries and activities I have mentioned we can trace a connection with other parts of the Empire. Crude cane sugar and rubber are imported from the West Indies. Among imports from Great Britain are motors, ships, harbour equipment, water works equipment. Large gates for hydro development are obtained more cheaply from Great Britain than in Canada or the United States, also steel window sashes, metallurgical equipment, woollen and leather goods.

This means that Canada must adjust her business and engineering to Empire possibilities. Canada is in a direct line geographically between Great Britain and the East. The importance of this position is indicated by the appearance of freight trains crossing the country on express schedule carrying cargoes of silk valued at $2,000,000 from Japan to Great Britain.

Britain's Post War Empire Policy.

The trend of post war policy in Great Britain is indicated by the proposals put forward by Lloyd George last week. They embrace three subjects. First, unemployment and relief—the giving of doles is to be stopped and work encouraged. Second—emigration to the Dominions—the right kind of emigrant is to be encouraged. Heretofore the difficulty has been to get suitable emigrants. Too large a proportion has been from the cities. The policy now is to send men from the country districts. Third—export credit—financial arrangements whereby firms overseas can do business with the Old Country, using a credit system not available heretofore.

These proposals mean the export from Great Britain of men of the right sort, materials, and money in the form of credit. Engineers should keep in mind that Canada must have people and money. These are now being put in our way by the new Empire arrangements, so that we can help both ourselves and the Empire. With this exchange of money, people, brains, and education, we are bound to have a prosperous period ahead of us.

THE ENGINEERING INSTITUTE OF CANADA.*

By G. T. Clark, B.A., C.E., Designing Engineer Toronto Harbour Commission.

THE President of your Engineering Society has asked me to address the undergraduates in Engineering and gave me the privilege of choosing my own subject. I am going to attempt to tell you what I believe the Engineering Institute of Canada is doing, and can do, for the engineer of to-day, both graduate and undergraduate. The necessity for conserving and developing natural resources to the utmost is receiving world-wide recognition at the present time. The development and conservation of natural resources can reach a high state of efficiency and economy only by giving primary consideration to the conservation and development of man power. The man power of Canada is developed in one direction by an elaborate system of education, public schools, collegiate institutes and universities. A considerable sum of money is spent on every engineer that graduates from the University. He is intensively trained up to a certain point after which no one assumes any responsibility for his professional advancement.

*Address delivered before the Engineering Society, Nov. 23rd, 1921.

I sincerely hope the time will come when the Federal and Provincial Governments will get some tangible return from the money invested in engineering education by applying the engineering man power so created to the development of industry and to the conservation and development of natural resources. Such procedure would certainly be in the public interest. In the meantime there is an organization at work trying to improve the value of the engineer to the community. This organization is known as the Engineering Institute of Canada.

What is the Engineering Institute of Canada? This Institute is the national body of Canadian Engineers, including among its members representatives of all branches of the engineering profession.

The scope of the Institute has broadened out materially since its name was changed from "The Canadian Society of Civil Engineers." There was a time when the meaning of the word "Civil Engineer" was so broad as to embrace every possible line of engineering work, and was used to distinguish from Military Engineering. During that time the Canadian Society of Civil Engineers could have been justly considered as truly representative of all its members no matter in what special branch of engineering they were engaged. There was also a time when the mere interchange of technical knowledge among the members of a technical society was of sufficient interest to sustain an organization in an active condition. But times have changed. The Engineering profession has broadened out to an enormous extent; numerous new branches and activities in the profession have been created. Civil Engineering itself has become narrowed down to mean and include only certain, definite and limited lines of engineering undertakings. Other lines of engineering, equally as important, have become developed and justly demanded independent recognition and designations as major branches of engineering, such as Mechanical, Electrical, Mining and Chemical. It was no longer possible to include all members of the profession under the title of Civil Engineering, and it became imperative to change the name of the society so as to make it unmistakably representative of the entire profession. It was thus that the name of the Engineering Institute of Canada came into being.

Likewise, the activities ot the Canadian Society of Civil Engineers, which were limited chiefly to interchange of technical knowledge among its members, were beginning to lose their attraction in the eyes of the new members, particularly the younger men. With the limited and narrow activities it was no longer possible to create sufficient enthusiasm to warrant the growth and expansion which such an organization requires in order to live. Changed conditions brought about by economic developments in recent years made it quite evident that above

all the engineer is human, and in addition to the technical problems that he meets with in his daily work he also has other problems, in common with the members of all other professions and classes in the community, which should receive his earnest attention. It became apparent that if the Canadian Society of Civil Engineers was destined to become the leading organization of the engineering profession in Canada it must assist its members in the solution of their human problems as well as their technical problems, even if to do so it might have to abandon some of its old traditions and recognized policies.

It is generally recognized, I believe, that the re-organization of the Canadian Society of Civil Engineers into the Engineering Institute of Canada paved the way for broader activities in new spheres which will ultimately result in greater usefulness of the Institute to the individual members, and of the members of the Institute to the general public. Our organization as founded and in existence to-day is, it seems to me, bound to be successful, because its constitution is flexible enough to be capable of adjustment to the constantly changing conditions and requirements of its members.

What is the objective of the Institute? The answer is given in one word—Service. To justify its existence the Institute and all its activities must be dominated by the desire and the determination, backed up by the individual effort of every member, to be of service to the Nation and the community and to its own members.

In regard to the service which the members of the Engineering Institute of Canada can render to the general public, to their home community and to the Nation, the problems which Canada has to face in the immediate future are problems in the solution of which the engineer must play an important part. The influx of foreign population, which will be great, is bound to create a situation to deal with which will require the utmost wisdom.

We as engineers should see to it that we are not in danger of repeating the discreditable slum conditions prevailing in the Old World, conditions which are productive of disease and physical and moral deterioration. The Engineering profession should be able to do more than any other to advise measures to deal with this problem. It means improved methods of economical house construction. It means good roads at moderate cost. It means a scientific planning of streets and parks, and it means a rapid transportation system with moderate fares to relieve the congested districts. The incoming immigrant must be Canadianized, and in what better way can this be accomplished than by showing him that the new conditions in which he will live in Canada are infinitely better than those he left behind. The trained intelligence of the engineer will always be a factor in the solving of this most difficult question.

The second way in which members of the Institute can be of service to the Nation is in regard to the present industrial situation. One of the important factors of the present-day industrial stagnation is the high cost of construction, and yet there has been very little organized effort on the part of engineers to promote construction activity. There is a growing feeling, however, that engineers should become leaders in political economy and a strong conviction that the time is opportune for engineering organization to take the leadership in persuading the public to support every truly economic plan for public works.

The assuming of such a leadership by engineers would be well-timed because the recent war has taught the public much about the importance of engineering, and because the present business depression makes it generally evident that a revival of construction activity will assist in accelerating the wheels of industry.

In a recent article in the "Engineering and Contracting" it was pointed out that the construction industry is one of the five greatest industries in the country. Construction is divisable into three classes—private, public and semi-public. Approximately 30 per cent. of the whole is private and the remaining 70 per cent. is public or semi-public.

In order to stimulate construction activity there should therefore be concerted effort to convince the public that when times are hard public works should be started on a large scale. It is false to argue that when private companies are reducing expenditure for construction, Governments and municipalities should do likewise. If engineering societies would take the lead they would find it easy to secure the co-operation of various public bodies and the daily papers, in spreading propaganda favorable to a programme of extensive public works.

In a special bulletin recently issued by the United States Chamber of Commerce the statement is made that one-fourth of their national wealth is represented by the structures and projects built by the construction industry. The current importance of the industry is indicated by the fact that one-fourth of the persons engaged in manufacture are working on material and products that the constructor will use, and it is for the engineer and architect to plan how this huge amount of material is to enter into the actual construction. The majority of engineers, I am afraid, do not fully appreciate their value to the community.

Herbert Hoover, addressing the American Engineering Council on taking up the slack in industry, referred to the thought and influence of their 200,000 professional engineers, and continued: "This great body of men in administrative and technical service penetrates every industrial avenue and thus possesses a unique understanding of many of our intricate economic problems and an influence in their solution not equalled by any other part of the community. Wanting nothing from the public

either individually or as a group, they are indeed in a position to render disinterested service."

And thirdly, in connection with the solution of the huge problem of transportation, what possibilities there are for the trained mind of the engineer to visualize the future greatness of our country and to assist in laying the foundations for a transportation system comprising a network of highways, railways and waterways which will adequately serve the growing needs of a growing nation. The development of the Ontario Government's system of provincial highways; the Federal Government's system of Canadian National Railways of 28,000 miles, the greatest mileage of any railway system in the World; the Canadian Pacific Railway, second only to the Canadian National in mileage; the hydro-electric power systems, whose output will some day help to solve the fuel problem on our railroads; and the proposal now under consideration to improve the St. Law rence waterway to accommodate ocean-going boats, open up a field for service unprecedented in the history of the profession in Canada.

May I be permitted in passing to refer briefly to one of these great projects, namely, the St. Lawrence waterway project, which, it seems to me, is one of the biggest and most far-reaching questions before our Federal Government to-day.

Early in 1920, Canadian and United States Government Engineers were requested by their respective Governments to report to the International Joint Commission on the further improvement of the St. Lawrence River from Montreal to Lake Ontario to make it navigable for deep-draught vessels of either the lake or ocean-going type, and to obtain the greatest beneficial use from these waters. While the Engineers' report was being prepared the Commission, consisting of three members appointed by the Canadian Government and three members by the United States Government, held sittings in many Canadian and American cities to take evidence for and against this project.

The Engineers reported in June, 1921, and their report is a favorable one. The total distance from Ogdensburg to Montreal is 182 miles, and the difference in elevation between these two points is 224 feet. By the construction of only 27 miles of canals and nine locks the whole water-course is made navigable for deep-draught vessels, and 1,464,000 horse-power of electric energy is developed by damming the Long Sault rapids at Cornwall and Ogden Island. The total cost of the scheme as reported upon is $252,000,000. I have briefly referred to this great project because of the immensity of the undertaking; also because transportation charges are a big factor in the present high cost of everything, and the advocates of this scheme believe that it will go a long way towards reducing these charges.

I have so far referred to the services which the members of the engineering profession can render to the Nation and the community. Let us now consider some of the advantages that will accure to the individual members as a result of our being united in one nation-wide organization.

The Engineering Institute offers, through the weekly meetings, an opportunity for the acquirement and interchange of professional and general knowledge among its members. When the University training is finished we enter the larger and more bitter school of experience, and there we learn to value the opinions and assistance made possible through the chance to intermingle with fellow-members of our profession. Technical knowledge can be acquired by close application to study; next comes the ability to put your technical knowledge to a practical use. But success is still not assured without the personal relation, or business connection. Cultivate the acquaintanceship of the influential men in your community. Above all things convince them of your integrity and intensity of purpose. The man who is always trying ultimately gets somewhere. We believe that these meetings of the Institute should be a means also of acquiring much valuable information of a general nature. With that object in view this year's programme includes such subjects as Town Planning, Contract Law, Municipal Financing, Public Health and other matters of public interest.

The Engineering Institute can also be of service by promoting the professional interests of its members, first by securing proper recognition for the profession

As a result of concerted effort, engineers have already succeeded in obtaining special legislation in all but three Provinces of the Dominion. This special legislation is primarily intended to serve one main purpose, namely, to protect both the public and the profession from the results of the practise of engineering by those not qualified. If this principle is rigidly applied to any engineering legislation that may be framed it will be found that the engineer has received his full measure of protection. All that Engineers as a class are entitled to is some effective means of protecting their professional reputation and prestige. Legislation has been framed to meet this end, and so framed as to be for, and not at the expense of, the public weal. Anything beyond this may be defined as class legislation, which in the final analysis does not protect, but stigmatizes and would ultimately force the engineer into the position of having to protect his legislation instead of having his legislation protect him.

In the Province of Ontario last session the Advisory Conference Committee, the Ontario Provincial Division and the various Branches expended a great deal of time and effort on an Engineers' Bill for this Province. Unfortunately it was submitted to the Government too late to be considered by the Private Bills

Committee and had to be referred to a special committee, which did not report before the close of the session. There did not seem to be any particular opposition to the Bill itself, and I believe we are justified in believing that we will attain our objective during this session of the Legislature, provided every member of the Institute in this Province uses every means in his power to further the interests of the Bill.

The Institute can further serve its members by securing proper remuneration for engineering services.

A great deal has been said and written on this important topic during the past two years, and perhaps no single subject has received as much attention and consideration from the various Branches as the question of classification of and compensation for engineers. The Toronto Branch was the first, I believe, to submit a report on this matter. The report of the Special Committee was approved by the Branch and submitted to Headquarters, and since that time a number of other Branches have forwarded similar reports. Headquarters then decided, through their Committee on Policy, that it was a matter which they should take up. As a result of this action a Committee on Remuneration was appointed by the Council to study the whole question, using as a base the reports of the various Branches and having access to the schedule prepared by the Engineering Council of New York. Their findings have not been made public.

There is no doubt but that the problem of adequate remuneration is a difficult and complex one. The subject is closely allied with the whole question of economics, which in turn is an important phase of the problem of production. The production of the engineer is evident in constructing means of transportation, whether by rail or water, in the development of an irrigation project, in the inventing and perfecting of machinery, in the generation and transmission of electrical energy, in obtaining from the earth its store of mineral wealth, or in the chemical analysis of the metals and kindred building products. In every one of these processes the main objective is to obtain an adequate return on the money invested, and the engineer is depended upon to produce the desired result, and every detail in his daily work is thought out from the standpoint of economics. Probably a foreman with no technical training could design a steel bridge that would carry a train. The qualified engineer gets the same results, but uses ten or twenty per cent. less metal. The saving is not only to his principals, but to the Nation in the conservation of natural resources. This principle of economics enters into the daily life of the engineer more than into that of any other profession, and assuming the above statements to be correct, who is better qualified to deal with the big economic problems than the engineer?

At the present time the entire World is undergoing a period of economic readjustment, which has thrown everything out of balance. Uncertainty as to what the future may bring is affecting business relations. The wheels of industry are certainly not running smoothly, and not only individuals but whole nations are suffering as the result of adverse trade conditions. In such a chaotic condition of affairs one naturally asks the question what service could engineers render to ameliorate these conditions, to assist in speeding up the readjustment and to clear away some of the clouds of uncertainty that are dimming our vision. How tremendously worth while it would be if the engineering profession would grapple with and assist in solving this acute problem, and having done so, who would deny us a remuneration comparable with the service rendered? Let us place a higher estimate on our own value to the community, not only in our professional relations but in all matters of community interest, and employers of engineers as well as the public will be quick to accept us at our own valuation.

The Engineering Institute can also be of service to its individual members by maintaining a high standard of ethics in the profession. Our standing Committee on Ethics presented two reports to the Branch last year on a Code of Ethics for Engineers. The Committee will report further in the near future. Other engineering organizations are also attempting to write new codes of ethics. These efforts are, it would seem, a hopeful sign of progress, not necessarily because they will produce a good code of ethics, but because they will increase the thought which engineers will devote to their relation to fellow-engineers and to the public.

It is inevitable that each one of these engineers by virtue of such reflection will become more keenly conscious of the special trust with which he is charged by reason of his profession's place in community existence. Therefore, even without the production of an accepted code, co-operative study of the subject will yield benefits to the public as well as to the profession by quickening the professional conscience and recognition of the duty of service.

In addition to this, it is broadly true that any movement which aims to re-formulate basic principles of just conduct is of very special value at the present time, since the engineers' objective attitude is most essential to the World's reconstruction.

There is another thought that occurs to me in connection with this question of ethics, particularly in regard to our relation to the public. Why do engineers frequently harbor personal feelings against those with whom they disagree on technical matters? Engineers are perhaps more sensitive regarding disagreements of opinion than other classes, because they are accustomed to dealing with facts and with immutable natural laws.

They feel instinctively that there is about everything a definite position which must be right; what differs from it is wrong. There is, of course, a right and wrong to every question. but the difficulty is that most problems are so complex that we are unable, with absolute correctness, to appraise the value of each factor. Some problems are subject to exact mathematical determination, but by far the greater number of them call for the application of the standards of individual experience, in other words, of judgment.

We need, therefore, to realize that our opponent in the discussion may have as good ground as we for his conclusions and to derive from that reflection an attitude of tolerance, and respect, for opposing views. Above all, we need to regard problems as objective and to refrain, unless the grounds are very clear, from imputing motives to our opponents. Let there be fair, even strenuous, discussion, but let the personal relations be in nowise disturbed.

The Institute can further be of service to its members by seeing that due publicity is given to the work of the profession.

The ordinary means of obtaining publicity for the engineering profession are fairly numerous. The outstanding requirement under this head is for engineers as a class to participate in the affairs of Federal and Provincial Government. This contention is so fundamentally sound and so generally recognized that it is not necessary to enlarge upon it. It is true beyond argument that the recognition of the engineer as related to national affairs cannot be advanced or conserved unless the engineers themselves exercise active governmental functions in connection with the laws relating to, or incidentally affecting, the profession.

Among other channels of publicity may be mentioned the active participation of engineers in all general problems affecting the life of the community, and in developing such problems into specific schemes for Government ratification and administration. Conditions governing publicity in the broad sense demand that engineers identify themselves with all benificent movements and projects, particularly those which have a wide public appeal.

Why Should Undergraduates Become Associated With the E. I. C.?

The last phase of this subject to which I wish to refer briefly is, "Why should undergraduates in engineering become associated with the Engineering Institute of Canada?" In every city where there is a University there is a branch of the Institute, of which every prominent engineer in the community is a member. Student membership in the Institute and attendance at the weekly meetings therefore provides a possibility of meeting the older members of the profession. The extent to which this possibility may become a probability depends on your own initiative, and as previously stated in these remarks, do not forget that when a man has reached the age of 35 or 40 the best asset he can

have, in addition to his University training, is a business connection, or if that is not possible, a speaking acquaintanceship, some kind of a personal relation, with the influential men in the community, whether they be inside or outside his own profession.

In order to accomplish this you must cultivate the art of being a good mixer among your fellow-undergraduates. Do not spend all your time in the lecture-room and your study. They should have a proper proportion of your time in order to secure that training which is so essential in after years; but there should be time also for the non-technical activities of University life, and it is in the following up of these that you will acquire the rudiments in that art of mixing which in later years you will find almost as invaluable as your college training.

Then again, by becoming associated with the Institute you are giving your help to building up a nation-wide all-Canadian Engineering Society. The larger the membership the more influence the organization will have in furthering the interests of the members at large and increasing its standing as a body representative of the profession. As an example, the strength of the organization both in members and in the personnel of its membership is an important factor to-day in our efforts to obtain protective legislation.

Attendance at the weekly meetings of the Institute provides the further opportunity of encouraging public speaking. In the discussions of the various papers which are presented everyone present, if he so chooses, has a chance to take part, and it is there possible to develop and improve the very valuable art of speaking in public under circumstances where you will have the advantage of criticism of the kind intended to help. It is generally recognized, and in the majority of cases, only too true, that as a class engineers are too retiring. In public meetings they listen to speakers discussing subjects with which they themselves are more familiar, but on account of their inability to express themselves through inexperience, are compelled to remain silent. This point cannot be urged too strongly on the members of your society, because it is absolutely essential if your members are going to take their proper place in the profession and assume the responsibilities incidental to it.

At these weekly meetings also you will hear discussed both engineering and general topics. They should be of value by keeping you in touch with the larger engineering projects under consideration or construction, and with allied subjects. A knowledge of public health, for example, or public finance are absolutely necessary in order that you may become not only good engineers, but also good citizens. The educational value of these meetings alone make them more than worth while.

Achievements of Sir John Kennedy.

What appeals to me as one of the greatest inspirations one can get as an incentive for greater self-improvement is the read-

ing of the wonderful achievements of outstanding men, and so I am going to conclude my remarks to-day with a brief reference to the life of Sir John Kennedy, one of the most eminent engineers of the last generation, who died recently.

Sir John Kennedy, the great engineer, who died on October 25th, full of years and honors, found the port of Montreal a shallow roadstead and a haphazard aggregation of primitive wharves, a few feet above the water level, when he in 1875 was appointed chief engineer to the Montreal Harbor Commission. The port was a thousand miles from ocean water, and one-fifth of this distance, separating Montreal from Quebec, was a narrow, tortuous and in places dangerous channel, only twenty feet in depth, limiting its navigation to river and lake craft and the smaller ocean-going steamers of the day. Added to this handicap was the fact that the river at Montreal contained strong and tricky currents, which increased the difficulties of entering and leaving the port, while each spring the harbor was exposed to the possibility of serious floods, which not only wrought damage to the wharves and other shipping facilities, but also at intervals covered wide expenses of the city's lower level, causing great inconvenience and loss to the city.

These were the conditions existing when Sir John, then plain Mr. Kennedy, came from the Great Western Railway to take over the task of making Montreal an ocean port which should prove not only third in importance in America, and rank high among the world's greatest harbors, but in some features set the lead for all others. Fated to lose his physical sight fifteen years prior to his death and before the monumental work which he planned was fully carried out, he possessed from the beginning to the end of his life that inner vision of genius which sees design and achievement as one. A practical visionary, he might be called. When he spoke of piers one thousand feet in length for Montreal the scornful jeered, yet to-day ocean liners and freighters from all the seven seas lie at these piers. He built a breakwater one and one-half miles in length, averted forever the menace of havoc by floods and moderated the influence of the currents. Sir John himself designed dredges of a new type to meet the demands made by the engineering and geological difficulties to be overcome both in the harbor and in the river channel to Quebec, which under his direction was deepened to twenty-seven feet and made as safe for navigation, allowing for the fallible human equation, as the traditional mill-pond.

Although only thirty-seven years old when he became chief engineer to the Montreal commission, Sir John was already known as a leader in his profession, and he had had wide experience in railways, mining, water works and other branches of engineering. His reputation continued to grow; he became recognized among his fellows as an authority upon engineering

practice, and he was frequently called upon to advise upon large undertakings, both in and outside of Canada, by governmental, public, and corporation bodies. In his personal demeanor modest, approachable and kindly, sincerely religious and animated by a spirit of service, and taking a keen and cheerful interest in world affairs to the very end, despite his affliction, Sir John Kennedy was a type of the manhood which has helped to make Canada what it is, and of those whose work and influence will be impressed upon the generations to come.

ORGANIZATION.

By Prof. E. A. Allcut.*

AN old lady, more distinguished for piety than for learning, once stated that she was always greatly comforted by "that blessed word Mesopotamia." During the World War, and in the financial chaos that accompanied the Great Peace, the "Mesopotamia" of the industrial world was "organization." This was the panacea for every ill, and the "open sesame" for all the caves of national prosperity. What was to be organized, who were to organize it, and the nature and scope of the proposed organization, were either left conveniently to the imagination, or else varied with the experts who proposed it.

In considering this question, therefore, it is advisable to first define the term "organization," and then to consider its application and limitations. The dictionary states that "organization" is "the state of being organized." This does not carry us very far, but "organize" is rendered "to supply with organs" or "to arrange," and in this form it is capable of direct application to the engineering industry.

Schemes of national recovery are inevitably dependent on production. But what is "production"? In the engineering world there is no such thing as production in the sense understood in agriculture, as there is no growth. In this case, therefore, production is simply another name for transformation of material from one form into another more useful one. For instance, iron ore is a source of national wealth solely on account of its potentialities. It is useless in its primary form, but when smelted, puddled, forged and machined, it becomes an article that can be used directly to increase the comfort of human life, speed of

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transport, or means of communication. For this increased comfort humanity is willing to pay, and therefore the value of the material is increased by suitable transformations. In other words, engineering "production" consists of the increased value arising from work done.

But such an increase of value is useless unless it can be realized, and at this point the effect of competition comes into play. It is useless for an engineer to make an article to sell at $100, if his competitor can produce and sell an equally good article of the same kind for $80. In that case, the finished work will remain in his own stores, because the effect of the increase of value cannot be realized, and in due course the works will shut down, because money is continually going out to pay for raw material, wages, taxes, etc., and the income from sales effected is insufficient to meet the expenditure. His "production" therefore ceases to be a national asset, and his men are added to the ranks of the unemployed, to be an additional source of loss to the community.

The question next arises, "Why does one man require $100 when another can do the same work for $80?" In the case of different countries, or widely separated communities, differences in the rates of wages paid, or in the cost of transport, are large factors in determining prices. But where competitors are in the same district wages are usually standardized, and therefore do not enter into the question to any great extent, and cost of transport is obviously the same for both. The main differences are those of size and organization.

It is well known that articles made in large quantities can be manufactured at less expense than similar articles produced in small numbers, and thus the size of the business plays an important part in the economy of manufacture. A case in point is that of the automobile. If these were produced singly, they would be as rare and valuable as jewels, and only millionaires could afford to buy them. By making large quantities of similar machines, the cost of each machine is reduced to reasonable dimensions, and consequently the number of potential customers is greatly increased, providing the necessary market for the output of the factory. The principal differences between large and small works are those of arrangement, and therefore the whole question is narrowed down to one of organization.

This is an age of specialization. It has been proved repeatedly that if a man is doing the same kind of work continuously, he is able to perform that work more accurately, rapidly and economically than can a general practitioner. Therefore, instead of "Engineers," we now have "Civil, Mechanical, and Electrical Engineers," and subdivisions of these professions as the principle is further extended.

In the workshop, too, the old type of mechanic has been superseded by specialists in the form of Turners, Fitters, Grinders, etc., each restricting his attention to one kind of machine or process. It is quite a common experience for even a skilled mechanic, given a new machine or fresh process, to increase his output 500 or 1,000 per cent. after a few months' experience. Still more is this the case with the unskilled or semi-skilled operatives that are now employed on many special machines, and in determining piece work rates on a new job, rate fixers have to make allowance for the speeding up that is likely to take place eventually, and as the operator generally objects, disputes arising from this cause are not infrequent.

Obviously, as the output of a machine or man increases, the cost of the article produced decreases, and therefore machining operations are now planned to make the most of this fact. Machines are set up with special jigs and tools for performing one set of operations only, and if further work of a similar nature is required, the unfinished article is passed on to another machine of the same type, set up in a different way for the remaining operations. In this way time is saved by avoiding the delay which occurs when the setting or arrangement of a machine is changed for completing a series of processes. This involves the provision of more machines for doing the same kind of work, but each machine carries a greater load and so becomes a more economical unit.

The erection of machinery is facilitated in a similar way. Formerly the machined components were delivered to an erector or gang of erectors, and they undertook the fitting together of the machine from start to finish. These men had to be familiar with a great number of processes, and a good deal of experience was necessary before a man was deemed sufficiently skilled to be entrusted with the responsibility of such work. The natural consequence was that the men, when trained, were very valuable to the firm, and frequently stayed for many years in the same shop. In numerous cases, special jobs descended from father to son over several generations. With increasing specialization and a decrease in the amount of skill and experience required by mechanics, this state of affairs has largely ceased to exist. Machining operations are more accurately performed, and therefore the amount of hand work required is reduced. Machines and engines are now erected in sections, a definite part of the shop being allocated for the fitting together of each section, and then the various fitted components are delivered to the final erectors for assembly. The fitters thus become more expert at their own job, but their general adaptability is greatly diminished.

By sectionalizing and specializing the work in this way, its final cost is reduced, but the difficulties of shop transport are increased. When work is put through in small quantities, it is transported from machine to machine, and from shop to shop by

a general corps of laborers, working under the instructions of the shop foreman or superintendent. With specialized processes, the number of transportations increases in proportion to the number of processes, and therefore the transportation system must be carefully organized to avoid congestion and loss of time, and also the machines themselves must be arranged to give a minimum distance of transport from one series of operations to the succeeding ones, and as far as possible, to ensure a continuous flow of material from one end of the shop to the other. The machines should therefore be put down in the order of the various operations, so that new material enters at one end of the section and finished articles leave at the other end.

In shops dealing with large quantities of material, this result is sometimes produced by the use of belts or conveyors, which transport the materials or partly erected machines, from one operation to the next, until manufacture or erection is completed.

These methods involve the existence of organizing departments for the purpose of controlling and supervising each detail. For instance, the efficiency or planning department must arrange the works and the various shops in the first place, to reduce transport and operating costs to a minimum, and they must see that the most economical arrangements are made to deal with any alterations of plant or machinery that may be necessitated by improvements in the design of the finished product or in methods of manufacture.

The production and progress departments must see that the machines and erectors are kept continuously supplied with material, and that a minimum of stock is kept in the various stores, consistent with continuity of supply and allowing for possible production difficulties.

Such organization, therefore, is not an unmixed saving, as extra expenditure is incurred in providing new and special machinery, and in running the organization itself. This additional expense must be debited against the saving resulting from the improved manufacturing arrangements provided.

It is evident also, that when machinery and equipment are specially laid down for doing definite work in a certain order, the design of the final product must be standardized beforehand, as the cost and dislocation resulting from improvements in the form of the article, is likely to be considerable.

The organization must therefore be as elastic as possible, consistent with economy of manufacture, to guard against such rigidity, and the continued production of an inferior article on account of the cost involved in proposed alterations.

In these instances, it is necessary to handle large quantities of material in order to keep the machines and men fully employed, and this implies a large capital expenditure and consequently a big output to provide sufficient revenue for running the works.

The decisive factor, therefore, is the market available for the finished product, as, if the whole output cannot be sold, the works must eventually stop, and thus, the organization or arrangement of any works, must depend upon the quantity of similar articles that can be made and disposed of in a given time.

Although scientific control and arrangement of factories are very attractive propositions in theory, particularly for young engineers, the extent to which the various schemes, so plausibly advertised, can be carried in practice, varies considerably in different classes of work.

It should be clearly understood that the management must run the organization, and not the organization, the mangement. Too many firms have been "organized to death," and the success of any manager is determined by the extent to which he can build up his organization without overburdening his works by excessive overhead charges.

It is quite an easy matter to spend a dollar in order to save ten cents, but the final test of any system is the amount of money saved by it, **after deducting the cost of the system itself.** When it becomes a burden instead of a saving, it is better to recast the organization on a more sensible and economical basis, and not until then does the system become truly "scientific."

AMERICAN ARCHITECTURE.*

By John M. Lyle.

I AM going to try to give you some idea of the great American Renaissance in Architecture which has been in full swing now for the past fifty years. I want also to tell you something of the architects themselves, many of whom I am fortunate in knowing personally.

You must bear in mind, however, that the opinions I shall express to you are purely personal and not in any sense dogmatic, for it is a great mistake to be too dogmatic in matters of taste. One must always remember that taste is an ever-changing factor, and that no two persons will agree as to what constitutes good and bad taste. What we like today we may abhor in ten years' time.

Taste and charm in architecture are qualities that are difficult to define, and must be felt to a large degree. They are, however, noticeable qualities in the work of all great architects.

I should like to urge on you all the great importance of cultivating the æsthetic side of your education; much of this you must get for yourself entirely outside of your practical and technical studies in the University or in the office.

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*Synopsis of an address delivered before the Architectural Club, March 14th, 1922.

This is doubly important for the Canadian student, because he has not the advantage of the European student in being able to see masterpieces of architecture, painting and sculpture staring him in the face at every turn.

How, you ask, is he going to form a standard of taste without going abroad?

My advice to him is, that given a certain amount of natural liking for the beautiful, he can, by study of the most interesting and fascinating kind, acquire a standard of taste that will be invaluable to him in his future career, and moreover he can continue his studies along these lines until he is ready for the grave.

He must learn of painting and painters, of sculpture and sculptors, of stained glass, of tapestries, of furniture of the different periods, of china, of silver, in short, of all objets d'art. It is a life study, but an entrancing one. He must read books on these subjects and books on the lives of the men who worked the masterpieces of the past.

He should not fail to go to the picture galleries, the Museum here should be an open book to him—and in this connection I should like to congratulate Professor Currelly on the steps he is taking to develop the art side of the Royal Ontario Museum. We, as architects, do not wish a natural history museum or a curio shop, but an art museum.

It is a well known fact that one often lives and works in the midst of some great political or artistic movement, without really appreciating just what is going on.

That the United States has been going through a great renaissance in architecture during the past fifty years, is just now being recognized abroad. In my opinion, the work that has been turned out by the American architects during this period, far outshines that of any other country during the same time.

Rupert Brooke, the English poet, said some ten years ago that he placed among America's five greatest achievements her modern architecture. A writer in that conservative and very excellent English publication—Country Life—remarks that "Anyone who has visited America recently will realize that if magnificent modern architecture ten years ago was one of the five finest things she has produced, this architecture has now probably reached the first place."

We now find English architectural students coming over to McKim, Mead & White's office for summer office experience.

What are the outstanding features of American architecture?

1. Its scholarship.
2. Its solidity and simplicity.
3. Its restraint.
4. Its execution.
5. Its handling of monumental work on a big scale.

Dealing with the first—its scholarship—there is no question but that the training of the American architect has had a great deal to do with the success that has attended his efforts in solving the various problems that have come before him. Following the French, rather than the English methods of architectural education, he has learned how to study, how to attack a problem, and the great success of the American designer in solving problems and of using different styles, is largely due to his education.

While it is true that they have had unequalled opportunities, it must not be forgotten that the designers have risen to them and are primarily responsible for American architecture.

Very many of the foremost American architects are graduates of American universities, and have supplemented their American training by a European one, principally at the Ecole des Beaux Arts. I cannot remember a single American who was in France at the same time I was, who was not a graduate of Yale, Harvard, Princeton, Columbia, or some other university. These men spent anywhere from three to six years at the Beaux Arts. It was always a source of wonder to me how many of them could speak two or three languages. All were deeply interested in architecture and had their weather eye always open for a bargain in the antiques.

Second—Its solidity and simplicity. These are undoubtedly two marked qualities noticeable in American architecture. If you will pay attention to the slides which I am going to show you, I think you will agree that this statement is correct.

The American architect seems to have caught something of Sir Christopher Wren's spirit, who believed that architecture should have the attribute of the eternal and that the "little knacks" should be avoided.

The buildings seem to be made up of a few parts rather than of an infinite number of small parts, or in other words, they are well studied, well composed, with a consolidation of ornament and a simple treatment of wall surface, depending on their scale and proportion for much of their beauty.

Third—The restraint, noticeable in the best American work, is very patent when you compare it with corresponding English, French or Italian work. A building may be well proportioned and well composed as to mass, but if it is plastered indiscriminately with ornament, then the abuse of this legitimate device defeats its own object, even if the ornament be good in itself.

Fourth—The execution of the American work is of a very high order. I do not think that any country can show such a high standard of excellence as that of McKim, Mead & White, and this is also true of the work of many other firms.

I would give special credit to McKim, Mead & White for this reason, that they have always insisted on the highest possible standard in their stone work, brick, plaster, wood and iron

work; picking their contractors, who, it is well known, always figured high on their jobs, for they knew that none but the best work would be accepted.

Their influence has been one of the great factors in establishing a high standard of workmanship, ably supported by the younger men of today.

The great works that have been under way in the United States have naturally attracted many of the pick of the world's craftsmen. I know of several jobs where special workmen were brought from England, France and Italy for particular work.

Five—There are only two groups of architects who have attained a marked degree of eminence in the handling of monumental problems—they are the French and the American; the Italians have never grasped the fundamental idea in monumental work, which is so closely related to planning. I am not referring so much now to monumental buildings as to large developments involving group planning.

The Italian, of course, has given us some of the greatest individual monumental architecture of all time, but he rarely had that sense of placing a building or buildings so that they would count—at the head of an avenue, or to form the sides of a square. True, that Bernini's Colonnade, and Michael Angelo's wonderful Conservatore Group are masterpieces, but they are the exception. Many of the greatest buildings in Italy are lost by reason of their setting.

In the designing and handling of individual buildings of a public or monumental character, the American architect has shown great skill. True that one can often trace the influence or source of inspiration, whether Italian, French, English or Spanish, of much of the work; nevertheless, there is much personal feeling, resulting in an architecture which is distinctly American. They have realized that the bizarre and picturesque touch which may be so delightful in a small country house, is an absurdity on a bank or court house. They seem to have had the job in mind rather than the desire to use some particular piece of ornament or pediment to the detriment of the design.

To quote from T. B. Bennett in "The Studio": "Great architecture has in all periods seized upon the requirements of its client and by natural expression has transformed them into works of art. It has always frankly accepted the limitations of site, material, cost of construction, and used them as a means to an end."

"The ability of the American designer to seize upon and emphasize the essentials of his problem is noteworthy, a chapel, a bank, a library, or an office building, all indicate clearly their special purpose."

The essentials of American architecture can be defined in a few words, as the work of men of taste who have added knowledge to their ability.

ARTISTIC DESIGN OF BRIDGES*

By Charles Evan Fowler, Chief Engineer, Detroit-Windsor Bridge; Consulting Engineer.

THE use of such a title for this brief article, as is usual in similar discussions, "The Architecture of Bridges," would seem to the writer to point to a misconception of the real problem. There is as yet no architecture of bridges and it is doubtful if there ever will be any system of hard and fast rules to govern their artistic design.

There are, however, certain fundamental principles and certain elements of design which must be observed, if we are to arrive at a pleasing ensemble for any particular structure. The problem is much more simple if we are designing a stone arch bridge, or one of concrete, or one of reinforced concrete, than is the case when designing a steel span or series of such spans. However, there are certain basic principles that apply to any and every type of bridge.

Artistic Essentials.

Simplicity, Harmony, Symmetry and Proportion must be regarded in any design that would have any pretentions to beauty or artistic effect. They are the fundamentals of true architecture or artistic design, no matter what the structure may be to which thought is to be applied in its design.

"Then prove we now with best endeavor,
What to our efforts yet may spring,
He justly is despised who never
Did thought to aid his labors bring.
For this is art's true indication,
When skill is minister to thought,
When types which are the mind's creation,
The hand to perfect form hath wrought."

Simplicity means first a truth-telling structure, no subterfuges about the lines of stress, no covering of a concrete structure with a stone facing, no frivolous or inappropriate details, but a strict adherence to the necessary features, whether they are to carry the loads or to ornament the bridge.

Harmony is essential to a pleasing or artistic design, for without it the structure would be distasteful. Harmony not only as between substructure and the superstructure; between the various spans; between the spans and approaches; between the utilitarian features and the ornamental details, but with the surroundings as well.

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*Address delivered before the Civil Club, Wednesday, March 22nd, 1922.

Symmetry may or may not be essential to a pleasing design, although it usually is necessary if a truly artistic structure is to result. Where the bridge has great length, unsymmetrical features are not so noticeable as in a shorter one, which may all be seen at a glance. As is often true in a landscape, balance must often be secured by including an unsymmetrical feature. That is, wherein one portion of a structure, a draw span or other unbalanced feature must be included that will destroy the symmetry, something must be introduced in another portion that will restore the balance, although symmetry does not result.

Proportion is necessary, that the three preceding principles may be realized, and usually, but not always, when the economical proportions have been determined, they are pleasing. However, in many cases modifications must be made to reach the point where economy and beauty can both be satisfied. Proportion of the details employed for ornamentation is quite another thing, and to be harmonious they must also be properly proportioned.

Examples may be seen in almost every structure of the proper application of some of these principles, but more often do we find most of them flagrantly violated. The remark made by C. Shaler Smith. the dean of American bridge engineers, to one of his assistants—"Most bridges are examples of what not to do"—must be remembered by anyone who wishes to attain to high rank in his profession. It is to be feared that in most cases we feel that, "in the long run, the average sense of the many is better for the many than the best sense of any one man." There is a right and a wrong; most engineers attain neither, in the hope they are right and the fear they are wrong.

Pleasing Ensemble Vital.

We need not care whether a detail is Byzantine, Greek, Roman, Gothic, or Renaissance if it is of the proper proportion, harmonizes with the other details, with the structure, and helps in forming an entirely pleasing ensemble. The Gothic arch was Persian before it was Gothic. Our structure may be similar to a work of architecture, in that it is neo-classic, but who would say that for this reason the Rathhaus of Cologne, or the Hotel de Ville in Antwerp, are not good pieces of art?

The diagonals or latticing in a bridge are sometimes unpleasing, and at other times in some other structure, not unpleasing. They probably originated with the savage, who used vines or fibre to form diagonals for his primitive structures. The farmer of today still uses ropes or wire for similar purposes, but as yet diagonal bridge members, nor yet the garden trellis, have been accorded a niche among architectural styles. The engineer, for some scores of years, has calculated his diagonals, and used them in his design because he believed they were necessary, no matter how incongruous they appeared. Now we know how to provide

for secondary stresses and can often omit the diagonals whenever a more pleasing structure will result.

Ornamentation

The curved lines of the suspension bridge and of the arch are inherently beautified, and simplicity is best illustrated in its pleasantest features in bridges of this type with no decorations or embellishments of any kind. However, we must not overlook the fact that even a chaste design may be much improved in appearance by the use or addition of appropriate and harmonious details or decorations. The suspension bridge seems sadly designed where the towers are not properly completed by a parapet or attic storey for those of stone, and perhaps crestings for those of steel. The arch is made more beautiful by molded work in the arch ring, by the use of appropriate medallions at the key stone, by the careful embellishment of the spandrels or spandrel arches, and lastly by the use of well designed and ornamented parapets and parapet railings.

Harmony is best exhibited where no part of a structure or of its decorations seem to be extraneous, and where the structure harmonizes with its surroundings. This latter feature is illustrated by the harmony of the battlemented towers of the Conway suspension bridge and the Conway tubular bridge, with Conway castle; by the harmony of the medieval towers of the London Tower Bridge with the Tower of London; and by the harmony of the stone towers of the old Brooklyn bridge with the high buildings of New York City, although this is but a happy accident, as the buildings were the later development.

Symmetry

Symmetry in its simplest form is where one-half of the structure is exactly like the other half, where one approach is like the one at the other end of the bridge. That is where the structure is perfectly balanced in the simplest manner. The most pleasing design is where the centre of the bridge is at the centre of the middle span, or it may be stated as a fundamental principle that an artistic bridge must have an unequal number of spans—one, three, five, or seven in number; but beyond seven spans the eye does not so readily grasp the whole and seek for an opening instead of a pier at the centre. Likewise the spandrel arches of an arch bridge must be three, five, or seven in each half of the span, or where they extend across the key stone, an unequal number for the whole span.

Proportion is most nearly reached when the whole structure is most pleasing to the trained eye, and the truth most closely adhered to in every part of the structure and in every detail. The use of too great a sag in a suspension bridge, or of too great a rise in an arch bridge dwarfs the apparent length of such a span. That is, too great for appearance, even if not too great for economy.

Careful Study Needed.

We must remember that there is nothing really in common between the architecture of buildings and the artistic design of bridges. The lack of any attempt at artistic design in the Williamsburg suspension bridge is deplorable; the failure to complete the towers of the Brooklyn Bridge is deplorable; the attempt at an artistic design for the Manhattan bridge produced a structure which is only not unpleasing; but in the Hell Gate arch we have a structure which is of great simplicity, of real harmony, of true symmetry, and perfect in proportion. It is not often given to man or to the engineer, to attain nearly to perfection, seldom more than once; but by careful study and thought, we can obviate very many flagrant violations of the artistic in the design of our bridge structures.

"Chisel in hand stood a sculptor boy,
With his marble block before him,
And his face lit up with a smile of joy
As an angel dream passed o'er him.

Sculptors of life are we as we stand,
With our lives uncarved before us;
Waiting the hour when at God's command,
Our life dream passes o'er us.

If we carve it then on the yielding stone,
With marks of deep incision,
Its heavenly beauty shall be our own,
Our lives that angel vision."

THE SCHOOL OF ENGINEERING RESEARCH.

By Maitland C. Boswell, Assoc. Prof. of Organic Chemistry, Secretary.

THE School of Engineering Research of the Faculty of Applied Science and Engineering of the University of Toronto was established in the spring of 1917, upon the recommendation of the late Dean Ellis.

It is under the direct supervision of a committee of management composed of fifteen members of the faculty council. To this committee is entrusted the selection of researches to be undertaken, from among those proposed by members of the staff, and the disposition of funds for conducting them.

The School was organized chiefly for the training of graduates in the methods of research, and for the carrying out of investigations. These latter may be problems relating to specific industries or raw materials and having a specific end in view, or they may be general problems having to do with fundamental principles.

A number of research assistants are appointed annually in the various departments of the faculty to carry on the work of research, under the direction of members of the staff. The facilities of the School are also open to other graduates, who may wish, either to obtain more experience in research, or to carry on investigations arising out of their own work since graduation.

A modest request for funds for the salaries of research assistants, and for the purchase of apparatus and supplies necessary for several specified investigations, having met with an encouraging response from the President and the Board of Governors of the University, the first research work, carried out under the auspices of the School, commenced at the opening of the session, 1917-18.

The success of the School at the outset was somewhat greater than usually attends a research movement in the year of its organization. Although papers containing the results of investigations constitute only one means by which the success of a research movement may be estimated, yet this is an important criterion of its growth. Bulletin No. 1, with fourteen papers, containing the results of investigations in six departments of the faculty, appeared in the autumn of 1919, and was very favorably commented upon by numerous engineers, investigators, and scientific and educational bodies, among whom it was given a wide circulation. The establishing of the School was justified, and those actively engaged in its work were encouraged to still further expand its activities. Further researches were under-

taken, requiring a greater number of research assistants, and more apparatus, the increased expenditures being generously met by larger appropriations by the Board of Governors. Bulletin No. 2, containing seventeen papers, has just appeared, and will be followed during the coming summer by Bulletin No. 3. The very favorable reviews of the papers of Bulletin No. 2, which have already appeared in the scientific journals, as well as the increasing number of requests for papers and bulletins, are very encouraging indications of the steady progress of the School. So great was this demand for separate papers from engineers and investigators in many parts of the world, that the editorial committee decided to publish subsequent bulletins in sections, each section containing a paper or group of papers dealing with a single problem or group of related problems, the main bulletin consisting of several of these sections bound together in a single volume.

However, it is not in the publication of papers alone that the effects of a university research movement are felt. Of equal importance is its influence upon the undergraduate. Contact with a larger number of graduate students and members of the staff, who are carrying on research work, will more quickly develop the desirable point of view of the investigator, who reads the current literature of his science, and the original sources of information, rather than text books, which often have a tone of finality, and thus tend to leave the impression of science as a finished product, instead of as an organism undergoing constant change and growth. Thus, the undergraduate will be induced to develop his knowledge of the principles and laboratory technique of his science, so that he also may play a part, either in extending the bounds of knowledge, or in assisting in its applications to industry. The importance of this reaction of the School of Engineering Research upon the undergraduate, which will be more and more apparent as the School develops, can scarcely be overestimated. It is just this investigating quality which characterizes a university, and distinguishes it from a high school. A university is not a hopper through which huge masses of predigested facts are poured into students' heads.

This research movement has had a very encouraging and promising beginning. It has met with a considerably greater measure of success than is usual with new research organizations. That it may continue to grow, until it comes to occupy a position in the life of the university and the state, comparable with that attained by the long established and justly celebrated laboratories of older countries, should be the earnest desire of all the students, graduates, staff and friends of this faculty.

March 9th, 1922.

SPECIAL WATER POWER LECTURES.

(Delivered Feb. 27th to March 6th, 1922).
By Professor R. W. Angus.

IN order to supplement in an effective way the courses in water power development which have been a part of the curriculum in engineering in the University of Toronto for many years, arrangements were made this session for a short series of lectures to be given by five prominent Canadian and American hydraulic engineers. The importance of developing our water powers has long been recognized and the hydraulic courses have always been shaped with this problem in view, and also with an idea of training engineers for water supply and irrigation.

After consideration it was thought best to deal with the water power development only, because sufficient time was not available without making the course much longer than was advisable at the present time of year.

In arranging the course, Professor Angus, head of the Department of Mechanical Engineering, under which the hydraulic work is done, invited five very prominent men who have become recognized authorities in a special field of the work, each of whom dealt with a different phase of it, so that in a brief way the whole problem of water power development was viewed from different angles and each detail received consideration. The speakers might all have been selected from graduates of the University of Toronto, amongst whom are many prominent hydraulic engineers, but the viewpoint of graduates from other Universities who have devoted themselves to this class of work was desired, and therefore, of the five speakers, only three were Toronto graduates.

From the outset the course was designed to be of particular value to advanced students and to practising engineers, so that the lectures were technical, rather than descriptive, and were of special interest to Fourth year men, but were also enjoyed by large numbers from the Third year as well.

Although the lectures chanced to come on the same week as the Engineering Society elections, which always take up much of the student's thought and attention, the attendance ranged from two hundred to three hundred on every occasion.

Addresses by Mr. Lewis F. Moody, Philadelphia.

The course opened with two lectures on Feb. 27th by Mr. Lewis F. Moody, a graduate of the University of Pennsylvania, and for some years Professor of Hydraulics in Rensselaer Polytechnic Institute, but now Consulting Engineer for the I. P. Morris Department of William Cramp & Sons' Ship and Engine Co., Philadelphia.

Under the headings, "Some of the principles controlling the use and design of hydraulic turbines," and "Hydraulic turbines and installations," Mr. Moody presented very difficult theory of the turbine in a concise form, deriving the necessary equations and illustrating his work by slides and sketches. He also gave a large number of slides showing the very latest turbine designs and illustrating the new high speed turbine, in the development of which he has taken a prominent part. A brief summary of this lecture has been printed elsewhere.

The new forms of draft tube, mainly designed by Mr. Moody and applied to some of the largest plants in the world, were fully discussed and their theory explained, although the speaker carefully concealed his connection with the inventions.

Address by Mr. Max V. Sauer.

The address by Mr. Sauer, a graduate of the University of Toronto and Hydraulic Engineer of Design for the Hydro Electric Power Commission of Ontario, dealt with the general considerations affecting the power house design and layout, and the speaker discussed various details of the plant. Starting with the selection of the turbine for a particular duty, Mr. Sauer discussed the exciters, governors, oiling systems, and other auxiliary equipment, laying much stress on the factor of reliability, which he regarded as more important than even the efficiency. The need of reliable oil pumps and air compressors was stressed and many practical points were mentioned.

During the discussion which followed many other points were brought forward and the session proved profitable and interesting.

Address by Mr. T. H. Hogg.

The next phase of the development dealt with was the consideration of the Intake, Head Works, Power Canal or Conduit Surge Tank and Penstock, and Mr. Hogg, Assistant Hydraulic Engineer for the Hydro Electric Power Commission of Ontario, treated the matter in a most capable way. Having outlined some of the troubles due to ice, he explained the principles governing the intake design and next took up the matter of the canal itself, outlining the general method of handling the problem and giving many helpful ideas and suggestions as to how such a difficult problem could be solved, incidentally commending the methods now being taught at this University.

The problem of the surge tank took a fair share of Mr. Hogg's time, and he showed why it was needed, and worked out some problems, supplemented by his experience, to show how important it is to make proper allowance for surges. All that was possible was to indicate the method of solution, both this problem and the former one being examples of the use of arithmetical integration.

Address by Mr. W. M. White.

The address by Mr. W. M. White, Hydraulic Engineer for the Allis Chalmers Co., Milwaukee, a graduate of Tulane University, proved a most valuable one. Mr. White had just returned to America after an extended trip in Japan, Formosa and the east, and spoke in a very interesting way of the developments in those countries in the hydraulic line, pointing out that they were realizing the very great value of water power in the progress of their nations.

Mr. White discussed primarily the Power House Machinery, showing how the draft tube affected the design and discussing the best form of the tube and the experiments that led to his conclusions. He also discussed the modern turbine development at some length and showed how the power house could be much simplified in good design, and also gave some interesting illustrations of how the best advantage may be taken of the head and volume and described some exceedingly novel power houses. His company was the only one, he said, which had supplied the most recent form of high speed runners to actual plants.

Addresses by N. R. Gibson.

The two concluding lectures were given by Mr. N. R. Gibson, a graduate of the University of Toronto in 1902, and at present Hydraulic Engineer for the Niagara Falls Power Co., Niagara Falls, N.Y. Mr. Gibson has brought some distinction recently to his Alma Mater by two important researches of recognized merit.

In his afternoon address Mr. Gibson dealt with the Regulation and Testing of Turbines, and set out fully how the problem of regulation was affected by the dimensions of the pipe line and penstock and also by the changes of load. He then discussed at length the importance of efficiency determinations and the reasons why these must be made with accuracy, but at the same time he showed how difficult it was to measure some of the elements, more particularly the quantity of water flowing. Mr. Gibson's simple and precise solution of this problem is well known to engineers and is likely to be almost universally employed, and his description of it therefore proved of much interest, but the discoverer very modestly neglected to mention his connection with it.

The concluding lecture on the evening of March 6th was also by Mr. Gibson and in it he discussed the economic features of water power development, explaining the conditions where water power is preferable to steam, the meaning of rates, the effect of the "diversity factor," and many other of the very important points connected with the sale of power. He concluded his lecture by a splendid set of slides showing the progress being made by his company with the new tunnel at Niagara Falls, and also the advances made in hydraulic machinery as illustrated in the plant he is connected with.

Very general satisfaction has been expressed everywhere with the entire course of lectures both by engineers and students and the results have fully justified the effort put forth. Those who so kindly gave of their time and ability to deliver the lectures have very deservedly earned the gratitude of this University.

SOME PRINCIPLES CONTROLLING THE USE AND DESIGN OF HYDRAULIC TURBINES*

By Lewis F. Moody, Philadelphia

BEFORE going into the hydraulic principles governing the action of hydraulic turbines, it will be well to look for a moment at a few views showing some simple forms of turbines and typical power-house arrangements, so that we are clear regarding the things which we are going to discuss.

Let us first be sure that we understand the two general classifications of turbines, and the line of separation between them. We are confronted at the start with the two terms used to distinguish these two classes, and these terms are probably responsible for many misconceptions. The terms themselves do not distinguish and have little meaning.

Impulse turbines are those in which the water under pressure is discharged through nozzles or orifices and its potential energy converted into the kinetic form, so that the water issues with all of its head converted into the velocity form at atmospheric pressure, or pressure substantially atmospheric. The water in the form of a free jet or jets acts against one surface of a series of open buckets mounted on a revolving element and the action of the water in passing through this wheel takes place entirely at constant pressure; this whole action being open to the air.

In the so-called "reaction" turbine, on the other hand, the entire operation takes place in a closed system of passages, the water being everywhere under pressure different from that of the atmosphere and the flow not being open to the air. In the modern reaction turbine, the water is discharged through a ring of guide vanes which give it a rotary or whirling motion about the turbine axis, its initial potential energy being converted only in part into the kinetic form, a cosiderable portion still remaining as pressure head. The water is then passed through a rotating runner in which the energy is abstracted from the water, the water discharging into a closed draft tube at a pressure usually considerably less than atmospheric and with a considerable amount of kinetic energy or velocity head still remaining in the water.

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*This is one of the lectures in the Water Power Development course arranged by Professor Angus.

The above names used to classify turbines perhaps originated in the one case in wheels in which a jet impinged on a series of flat paddles, and in the other case in wheels having a series of rotating arms dischargingthe water in backwardly directed jets. The latter device, known as "Barker's Mill," which somewhat resembles a lawn-sprinkler, is a true reaction turbine in the sense originally intended. It is interesting to note that neither the modern impulse turbine nor reaction turbine operates on the principles of the primitive wheels just mentioned. It is worth noting that the high-speed reaction turbine of today actually discharges the water from the runner in the same direction as the motion of the runner, so that its reaction, in the sense used originally, is in the opposite direction to the rotation of the wheel, tending to oppose its motion. Furthermore, both turbines are dependent upon the impulse of the entering water to produce the driving torque. In the following discussion of principles, we shall direct our attention chiefly to the reaction turbine.

I believe that most of those present are thoroughly familiar with the theory of the turbine, but hydraulics is a subject so liable to misconceptions that I think it may be useful for us to touch briefly a few of the high spots of this particular branch. In approaching any hydraulic problem, there are two possible plans of attack, both of which are worth keeping in mind.

The first is to establish energy relations; that is, to find out what becomes of the energy involved; and the second is to establish the conditions of equilibrium under the forces of impulse and reaction, that is, to depend on the principle of momentum of the moving water.

The first method makes use of the Bernoulli formula, and the second utilizes the fact that a flowing stream or jet exerts in the opposite directions to its motion a reaction equal to $\frac{WV}{g}$, where W is the weight of water discharged per second; V the velocity in feet per second; and g the acceleration of gravity. If a jet is discharged into a tank so that its velocity is destroped, or if it impinges on a plate so that no velocity remains in the original direction, it exerts a forward impulse of the same amount.

Applying the first method, we can write the Bernoulli

formula for the stationary parts of the turbine system, or any other system for that matter, as follows: (See Fig. 1.)

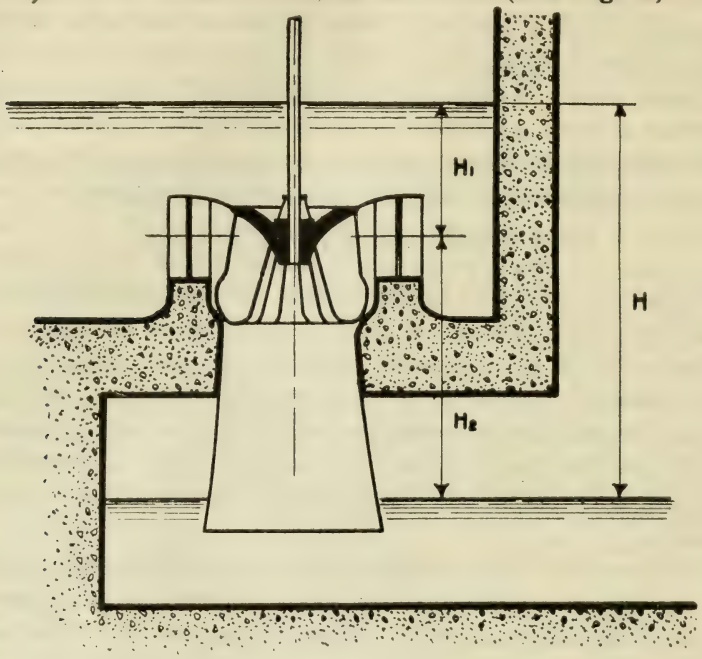


Fig. 1

From intake to entrance to runner

$$h_a + H_1 - L_1 = h_{p1} + \frac{c_1^2}{2g} \quad - \quad - \quad - \quad (1)$$

From discharge from runner to tailwater

$$h_{p2} + \frac{c_2^2}{2g} + H_2 - L_d = h_a + \frac{c_3^2}{2g} \quad - \quad - \quad (2)$$

in which h_a = head corresponding to atmospheric pressure
h_{p1} = absolute pressure head at runner entrance
h_{p2} = absolute pressure head at runner discharge
L_d = loss of head in draft tube
c_1 = absolute velocity of flow into runner
c_2 = absolute velocity of flow out of runner
c_3 = absolute velocity of flow out of draft tube

From entrance to discharge of runner. In writing this equation we must remember that in the runner a portion of the available energy is converted into useful work. A term must therefore be subtracted from the initial energy to leave the energy remaining at the runner discharge. The energy converted into useful work per second is W He, where H is the total effective head available for the turbine and e is the turbine

efficiency. Since in this equation we are talking about head, and since head is the energy per pound of water, the amount of head converted into useful work is He. We therefore have

$$h_{p_1} + \frac{c_1^2}{2g} - He - L_2 = h_{p_2} + \frac{c_2^2}{2g} \quad - \quad - \quad (3)$$

Or, from (1) and (2), we can find the effective head on the runner by taking the difference between the sum of pressure and velocity heads at entrance and that at discharge, also subtracting the loss of head in the runner, thus:

$$\left(h_{p_1} + \frac{c_1^2}{2g}\right) - \left(h_{p_2} + \frac{c_2^2}{2g}\right) - L_2$$
$$= H_1 + H_2 - L_1 - L_2 - L_d - \frac{c_3^2}{2g}$$

The second term is evidently H — (the total loss of head) which is equal to He, and substituting this and transposing, we again have equation (3).

The above relations may appear to be so elementary that they are hardly worth stating; and yet they have not always been observed. In particular, many turbines have been located at a height H_2 above tail water, which requires in equation (2) an absolute pressure hp_2 amounting to less than zero.

Let us now go a step further and apply the Bernoulli formula with reference to the rotating system of the runner. The method of determining the flow in a rotating system may be explained in a simple manner. Suppose we have to consider two tanks on a merry-go-round at different distances from the axis of rotation and at different elevations. How shall we determine the flow through a connecting pipe? If the system is stationary, it is quite easy to do this by applying the Bernoulli formula between one tank and the other, just as was done above for the turbine intake. If the system is rotating, however, let us imagine first that we have a single large tank located below the two tanks to be investigated. (See Fig. 2.)

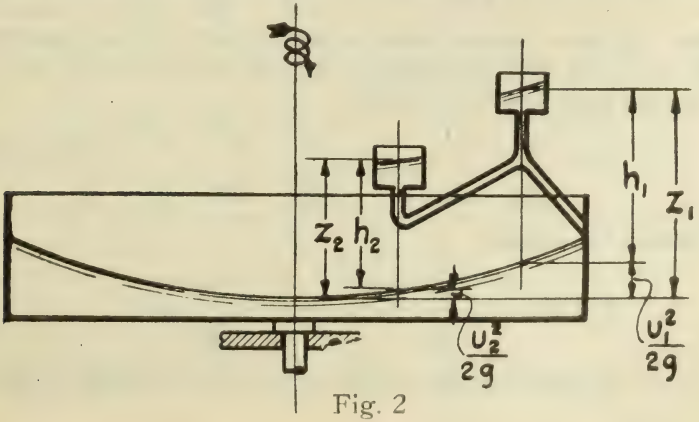


Fig. 2

The water surface in the large tank will take up the form of a paraboloid of revolution; and the difference of elevation at any two points in the surface, such as those just below the two tanks of the problem, is equal to the difference of the velocity heads corresponding to the rotation of the tank, that is, of the system. This difference of elevation is

$$\frac{u_1^2}{2g} - \frac{u_2^2}{2g}$$

Any particle in the water surface is in equilibrium and has no tendency to move either one way or the other. It is the amount of elevation above this surface which determines the head available to produce flow. Therefore, to apply the Bernoulli formula to such a rotating system, it is only necessary to measure all elevations above a paraboloidal surface corresponding to the speed of rotation. This surface becomes a datum surface, taking the place of a plane horizontal surface in stationary problems. Thus we have for the above problem:

$$\text{Head producing flow} = h_1 - h_2 = z_1 - \frac{u_1^2}{2g} - z_2 + \frac{u_1^2}{2g}$$

The effective head at any point of a rotating system is the sum of the pressure head, the velocity head due to the relative velocity, and the elevation head above the paraboloidal datum surface.

Applying this principle to the turbine runner from the point of entrance to the point of discharge, we therefore have

$$h_{p_1} + \frac{w_1^2}{2g} - \frac{u_1^2}{2g} - L_2 = h_{p_2} + \frac{w_2^2}{2g} - \frac{u_2^2}{2g} \qquad (4)$$

We can now obtain from either (3) or (4) an expression for the pressure drop through the runner and equating the two expressions thus found, we have:

$$h_{p_1} - h_{p_2} = He - \frac{c_1^2}{2g} + \frac{c_2^2}{2g} + L_2 = \frac{u_1^2}{2g} - \frac{u_2^2}{2g} - \frac{w_1^2}{2g} + \frac{w_2^2}{2g} + L_2$$

from which we obtain

$$He = \frac{c_1^2 - w_1^2 + u_1^2}{2g} - \frac{c_2^2 - w_2^2 + u_2^2}{2g}$$

Drawing the triangles at entrance and discharge from the

runner to represent the relation between the relative and absolute velocities at these points, we have Fig. 3. Here c_1 and

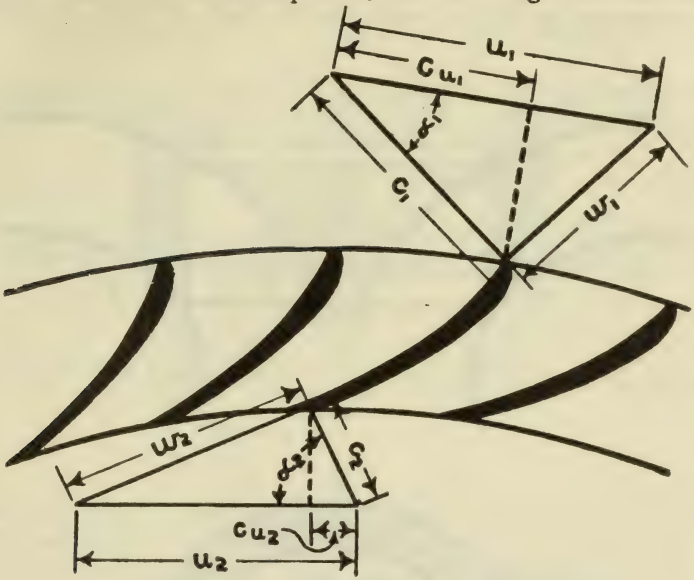


Fig. 3

c_2 represent the absolute velocity of flow, and w_1 and w_2 the velocity considered relatively to the rotating system; u_1 and u_2 being the corresponding velocities of points on the rotating system itself, that is, the circumferential velocities at the points of entrance and discharge of the runner. These relations between the relative and absolute velocities can be expressed trigonometrically as follows:

$$w_1^2 = c_1^2 + u_1^2 - 2u_1c_1 \cos \alpha_1$$

If we denote by c_{u1} the tangential component c cos α_1 of the absolute entrance velocity, which we may refer to as the absolute entrance whirl, and similarily if we put c_{u2} for the absolute discharge whirl $c_2 \cos \alpha_2$ we shall have

$$c_1^2 - w_1^2 + u_1^2 = 2u_1 c_{u2}$$

By the substitution of these values, (5) reduces to the simple relation

$$u_1 c_{u1} - u_2 c_{u2} = gHe \qquad - \qquad - \qquad - \qquad (6)$$

This equation is a fundamental one and forms a reliable basis for the design of a turbine. In the design of turbines of low specific speed c_{u2} may be taken as close to zero, and the second term may then be dropped. For the attainment of very high speeds, the second term may be given a considerable value in comparison with the first term. The turbine shown somewhat diagrammatically in Fig. 5 utilizes this principle.

If we approach the analysis of a turbine by the second method mentioned, we can proceed as follows:

Referring to Fig. 4, suppose we have a space bounded by

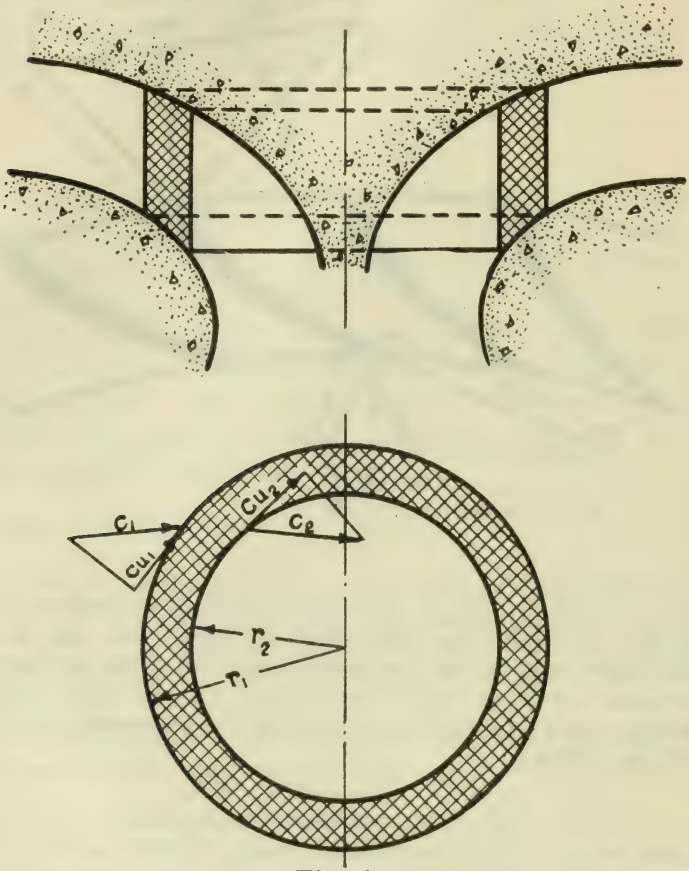


Fig. 4

surfaces of revolution swept up by rotating curves of any desired form about the axis, and let us suppose this space to be filled with water flowing inward around the periphery and outward at the bottom, this water being at the same time given an initial whirl in addition to its inward velocity. Suppose that the flow is steady, that is, the same from instant to instant, and consider the annular space marked by the double hatching. This ring is continually filled with water which is flowing in through its outer cylindrical surface of radius r_1 and out through its inner surface of radius r_2, and at any particular point in the space the velocity, pressure and other conditions will be constant with respect to time. This ring of water is therefore in equilibrium and the forces acting upon it are balanced, and the velocity at

any point has zero acceleration. The water entering the ring-formed space exerts a force in the direction of its motion equal to its weight multiplied by $\frac{V}{g}$, and if the total weight of water entering per second around the periphery is W, the tangential component of the impulse of each elementary stream of water will be equal to the weight flowing multiplied by $\frac{c_{u_1}}{g}$ and the moment exerted by all of the entering streams upon the ring of water tending to rotate it about the axis will be equal to

$$\frac{W r_1 c_{u_1}}{g}$$

Similarly, the backward reaction of the entire leaving stream will be

$$\frac{W r_1 c_{u_2}}{g}$$

the value of W, of course, being the same in both expressions, since the amount of water leaving is equal to that entering in accordance with continuity of flow. In such an elementary space containing no vanes, either stationary or rotating, there is no other force which can act upon the water in a circumferential direction and therefore the algebraic sum of the two turning moments must be zero or

$$\frac{W r_1 c_{u_1}}{g} - \frac{W r_2 c_{u_2}}{g} = 0$$

or $$r_1 c_{u_1} = r_2 c_{u_2} \quad - \quad - \quad - \quad - \quad - \quad (7)$$

This relation applies to any unobstructed space in which water may freely rotate, and can therefore be applied, for example, to the water after it is discharged from the turbine guide vanes and before it enters the runner, and to the water in a draft tube which is bounded by surfaces of revolution co-axial with the runner.

The spiral casing for a turbine may also be so formed that the flow within it conforms to the above relation and the same thing applies to the casing of a centrifugal pump. The writer considers this to be the proper condition to observe in the design of such spiral casings as it permits the flow to conform with the natural conditions which would exist if the spiral guiding wall were absent.

Let us now consider the conditions which we would have if the space of Fig. 4, instead of being unobstructed, contained a series of vanes. In this case, the moments of the entering and leaving water would be no longer equal and opposite, but they

would differ by the amount of the moment exerted against the vanes. (See Fig. 5.) In this way we would obtain for the

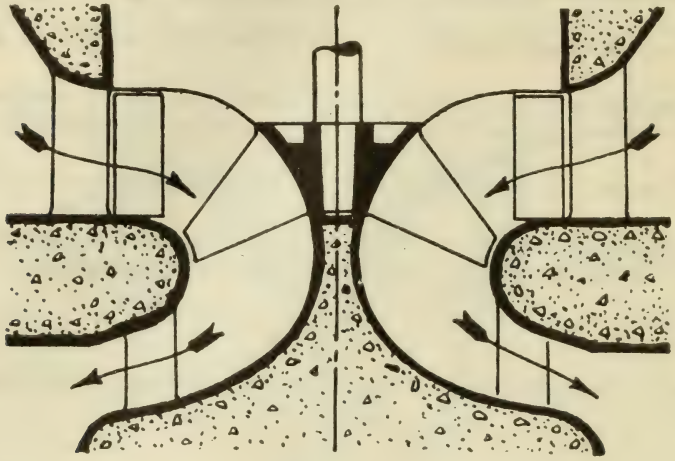


Fig. 5

moment exerted on the turbine runner the expression

$$\text{Moment} = \frac{W}{g} r_1 c_{u_1} - r_2 c_{u_2} \quad - \quad - \quad - \quad (8)$$

If we multiply this amount by the angular velocity w of the runner, we shall have the work done by the runner per second, that is,

$$\frac{W}{g} (w r_1 c_{u_1} - w r_2 c_{u_2}) = WHe$$

or, in terms of circumferential velocities of the runner,

$$u_1 c_{u_1} - u_2 c u_2 = gHe$$

This result will be recognized as the same as that previously derived from energy considerations (6). Although derived for the modern turbine, this formula is applicable to all forms, both reactions and impulse turbines whether the flow is in a continuous ring or divided into separate jets.

These relations are, of course, not new, although there are probably many opportunities for applying them which have not been utilized. Equation (8) was announced by Leonhard Euler in 1754 and the principle of Equation (7) was known in the case of a vortex to Leonardo da Vinci.

More specifically, these principles, when applied to a spiral casing of a turbine, call for velocities at various points around the circumference which increase as the water approaches the axis, the velocity varying inversely as the radius according to equation (7). When applied to the transition space between the guide vanes and the runner, in a turbine of the type of Fig. 5, if we start with a given velocity of discharge from the guide

vanes we can compute the velocity at various points along the entrance edge of the runner vane at different radial distances from the axis by multiplying the velocity in each case by the inverse ratio of the radii of the runner vane tips and the guide vane tips.

When applied to a draft tube formed as a surface of revolution (Fig. 5), this principle, which is simply an application of the principle of constancy of moment of momentum, calls for a velocity which automatically decreases as the distance from the axis increases. Such a draft tube, therefore, provides an excellent means for recovering the energy of whirl with which the water leaves the runner and permits the water to discharge from the outlet of the draft tube with very little energy of whirl remaining in it.

ESSAY ON "FIRE PREVENTION."

By T. S. Glover, Class of 1922, Civil Engineering.

"Now, altogether, hear them lift their lesson, theirs and mine,
Law, order, duty and restraint, obedience, discipline."

—Kipling.

PRIMITIVE peoples have made of fire a god. To us it is in danger of becoming a devil. One of the outward signs that distinguish man from the beasts of the field is the use of fire, and without it our civilization would have been impossible. The uses of fire are obvious, but the abuses of it are so little realized by the vast majority of people, that today we have special departments whose business is solely to shake us from our blissful slumbers, and hammer cold facts into our heads about the tremendous loss of life and property that is now, hourly, going on round about us. The expression "hammer" is used purposely, as any milder form of persuasion is useless, and can never succeed in breaking through our attitude of indifference to this glaring evil.

A Personal Problem.

Those of us who have considered the human make-up (and which of us has not) are eager to admit the beauty of self-control, of the strong and healthy mind that leads. We admire the great efforts that the engineer has made in controlling and directing Nature by dams, canals and all the many works he has designed. And yet, in the face of this lawless devil, Fire, that tears madly through our land, respecting neither low nor high, waving his red torch of destruction, we placidly go about our business, hoping that we at least may be spared. Then perhaps we see a fire, or read about some new triumph of the demon of fire, and wonder why someone does not do something to prevent this waste. When we have reached this point there is some hope of improvement. In

the particular circumstances in which each one of us is placed there is opportunity to awaken people to a sense of the futility of this fire wastage, and it is only when the great mass of public opinion decides that this shall not be that it will cease. There are men with brains to design fireproof structures if we want them. Till we want them enough to be willing to pay the comparatively small extra cost the same orgy will continue.

Care in Trifles Necessary.

We therefore want to prevent loss by fire. The word "prevent" means "coming before," or, as we should say, "getting ahead of." Our fire demon is endowed with intelligence of a high order, but nevertheless we have sufficient accumulated knowledge to be able to forestall his machinations, if we really set out to do it. Our frame house, lit by kerosene lamps, is an easy mark for him, and with what fiendish delight does he pounce on the little child playing by the unguarded fireplace. The airy tossing of our cigarette end into space, or what is more likely, into the waste-paper basket, is as good an opening for him as that offered by the man who looks for a gas leak with a candle. It is not so much technical knowledge we need, as ordinary common sense and a stiffening of our mental and moral fibre. We are so used to the comforts and conveniences of our modern life that we see no reason why we need go to a little trouble in the small things of our daily round.

Value of Education.

In a recent address before the Ontario Fire Prevention League, Dr. H. J. Cody stated that in his opinion the best way to bring about a great national advance or induce a beneficial national change, was to deal with the children. Train the child, and then, as the twig is turned, so will the tree be. It is far better to deal with the children than with the adult.

This means education, not by the teaching of a long list of "dont's" so much as by the inculcation of strong positive principles, such as cleanliness, law, order, duty and restraint, obedience, discipline. The child with a clear and well-ordered mind will instinctively refrain from untidy and slack practices, such as letting off squibs in the woodshed. He will know enough to go out into a field for the fireworks season. To quote Dr. Cody again, "The two great enemies of property and of fire prevention work are probably carelessness and uncleanliness: both of these have their roots in certain features of human nature. They are not merely material accidents, but are related to personality, and so, being related to personality, can be dealt with by the processes of reason and education along proper lines."

Loss in Life and Property.

Facts are very potent, solid arguments, and if there are any who need convincing of the magnitude of the danger, let them

ponder the following. In the United States and Canada, estimates show a casualty list of twelve thousand persons killed each year by fire. As in war, the deaths are not nearly equal to the injured, so that thirty thousand casualties a year from fire is no exaggerated estimate. The loss of material property from the same cause exceeds three hundred million dollars. Much of this loss is foodstuffs, and necessaries of life, a waste which is positively criminal. And who is responsible? In some cases the builders and architects, but in far more cases some foolish and careless person who handles fire in the form of matches, burning tobacco, and a hundred other forms. Those who have investigated the facts closely tell us that in Europe conditions are not nearly so bad. The reason is that the people have been educated, and know the dangers of fire, and the precautionary measures to be adopted against it. They realize that their country's prosperity depends on the efficiency of its people and industrial plants, and that the matter is not merely one which concerns insurance companies and fire brigades, but that it is the concern of each member of the community.

In this country the recent efforts of the Fire Prevention League have resulted in a very marked decrease in fire losses. In Ontario, during the first six months of 1919, a reduction of 40 per cent. was effected—proof that the educational methods used were sound.

Defective Construction.

Assuming now that the sympathy and co-operation of the large body of loyal citizens has been enlisted, let us turn to examine the responsibility of the structural engineer in the matter of fire prevention. Competent authorities state that the largest single factor contributing to the excessive fire waste in Canada is the indiscriminate use of wood for structural purposes. Out of possibly two million buildings, less than one-tenth of one per cent. has been built with proper consideration of fire safety. Nearly 70 per cent. of our buildings are of frame construction, and the majority of our brick buildings are inadequately protected against fire. It must, therefore, necessarily be a long time before the effect of more stringent building regulations will be felt and the problem consequently becomes not merely one of building new fireproof structures, but of remodelling existing ones so as to give a much greater factor of safety against fire.

Comparison of fire losses and of structural conditions in Canada and Europe leads to the conclusion that a radical change in building methods is fundamental to the curtailment of Canada's fire losses. Serious fires in Europe are exceptional occurrences, and conflagrations are almost unknown now. The fire departments in the principal European cities are certainly no better than ours, and in the smaller places, comparison would be ludicrous. Their greater immunity from destructive fires is undoubtedly due in large measure to superior construction.

A lack of thoroughness marks a large amount of our Canadian building, due to our giving way to the modern cry for speed. This leads to insufficient supervision and carelessness, not in the matter of structural safety, but of safety against fire. The responsibility for these conditions may be equally divided between the owners, architects, contractors and public authorities. Speculation and the desire for large returns by investors have been the cause of much poor construction in Canada. Efficient construction requires time.

Objection has been frequently made to the passage of ordinances requiring brick construction, on the ground that it would prove a hardship to builders by compelling a larger initial expenditure. After careful examination of the merits of this argument, it has been found that the additional cost in Canada of solid construction is so small that the prohibition of frame buildings, at least in cities and towns, would involve no real hardship.

Hazards to Life.

The relation of construction to the safety of the lives of those who occupy buildings is self-evident. The danger to human life is influenced by (1) the material used in construction, (2) the design, (3) the facilities for escape, and (4) the physical and mental condition of the occupants. It is clear that the materials should be incombustible, and be employed in such manner as to overcome any inherent defects or weaknesses. Unfortunately, a building, even when constructed of fire-resistant material, and equipped with every safety feature and device, may be filled with inflammable and combustible contents, capable of generating gases, smoke and heat sufficient to destroy the lives of the occupants. Well designed and constructed fire resistant walls will, however, confine a fire to the space in which it originates.

The safety of a building is largely influenced by its design. The maximum separation of the exits, the safe enclosure of the stairways, the proper introduction of fire walls and the character and degree of the fire protection are all important details. In order to secure economy of design it is necessary that the purposes and uses of the building should be definitely known. Thus, the correct amount of fire protection may be provided against the exterior fire hazard, and, by dividing walls or partitions, fire-doors and fire-extinguishing apparatus and equipment, protection may be provided internally.

Value of Fire Walls.

The usual means of exit are (1) elevators, (2) outside fire escapes, (3) stairways, and (4) the fire-wall. There are only two kinds of safe exits—the enclosed fireproof stairway and the fire-wall—but the former has serious limitations and is not suitable for crowded buildings. The only real and practical solution of the problem of safety in buildings is a bi-sectional fire-wall. It

is, moreover, the least expensive solution of the problem if properly and economically applied. There is, unfortunately, a widespread prejudice against the fire-wall, but this is largely due to the lack of knowledge of the manner of its application to the life hazard.

Its merits and advantages as a safeguard and protection to property have long been recognized by underwriters. Where it is introduced, the conditions in buildings are so changed that large economies can be made in the cost of additional exit facilities. In most cases this saving more than offsets the entire cost of the fire-wall and materially reduces the total cost of the building. There should be at least one stairway and one elevator on each side of the fire-wall and the wall should have at least two openings in it at as great a distance from each other as practicable, and both should be closed by standard fire-doors.

It is improbable that a fire will occur on both sides of the fire-wall simultaneously. Should it occur on one side, the people on that side would pass through the doorways in the fire-wall, close the doors after them and be perfectly safe. The half of the building in which the fire occurs can usually be emptied in less than a minute if there are not more than 300 people on each floor, and an average of 150 have to pass through the doorways. If the principle of the horizontal escape presented by the fire-wall is correctly applied in new buildings, a most satisfactory method of securing safety at comparatively small expense will be obtained.

The minute details of this work afford material for a long course of study in themselves, and the engineer has first of all, in designing any structure, to consider its strength to bear the load expected of it. But this does not imply an absolute disregard of the principles of fire protection. On the contrary, a closer study of such principles is becoming a necessity in our engineering colleges, if we are to proceed in the campaign for education in fire prevention equally at all points of the line.

THE CANADIAN INSTITUTE OF CHEMISTRY.

By Prof. J. Watson Bain, President.

THROUGHOUT the greater part of Canada the titles "chemist" or "chemical engineer" may be freely used by any person whomsoever, without fear of prosecution under the law. As a natural consequence a number of persons, quite unfitted either by training or experience, have, by assuming these names, misled the public into disastrous investments, or into futile expenditures for experimental purposes. It may safely be

stated that there is no graduate from a chemical course in a university with five years of professional experience who has not had a considerable acquaintance with the quack chemist and with the financial losses which his trusting clients have suffered.

In the light of this situation, the resolution of a large number of professional chemists, gathered at a convention in Ottawa in 1918, to form an organization for the purpose of elevating the status of the chemist in Canada requires no detailed explanation, and after a year's careful study of the matter, a second convention of Canadian chemists in Montreal in 1919, decided to form a Canadian Institute of Chemistry. Members were enrolled and a council was elected; the drafting of a constitution and by-laws was commenced which proved to be a difficult and laborious task. Only in August, 1921, did the Institute secure its charter from the Dominion Government and commence its career legally, although in point of fact it had been growing and functioning vigorously since its birth in 1919.

There are two classes of members: Fellows and Associates, entitled to use the letters "F.C.I.C." and "A.C.I.C." after their names respectively.

The Institute aims primarily to raise the standard in the profession, and to this end admits to its membership only those who are qualified by training and experience. Judging from the record of the Institute of Chemistry of Great Britain, which has now been in existence for 45 years, every chemist practising outside the universities will consider the appending of these four letters to his name as an honorable distinction and a valuable asset.

During their college course, students are invited by the Institute to join its ranks as student members; a year after graduation, with suitable experience, they may become Associates, and with further experience, Fellows. The older men in the profession secure little value for their membership, for their positions are already established; the younger men, on the other hand, have everything to gain by allying themselves with the movement for raising the professional status. To every young chemical engineer or chemist, who reads this, I would say: This is more your business than it is mine; if you are not interested in your professional future, who else will be?

STRESS ANALYSIS.

T. R. Loudon.

IN the following discussion will be found outlined methods of determining the stress on various planes in material subjected to the deforming action of external forces. Stress is the resistance offered by material to any effort to change its shape. Just what constitutes the ultimate nature of this resistance is a question that is involved in the discussion of atomic structure, mass and energy; an extremely interesting problem, but a still somewhat speculative investigation.

The mathematical analysis of stress in three dimensions is rather complicated, but should the reader desire to pursue further the subject as outlined in two dimensions in these pages, a bibliography will be found at the end of the article from which the necessary information may be obtained.

The state of stress in a body is related necessarily to the deformations or strains in the material under discussion. In the following argument, the strains are entirely neglected and the subject approached from a purely Statical standpoint. This method is somewhat easier to follow and gives results that are as close to those deduced from practical experiments as does the method of determining stress by considering the strains. For it must be remembered that neither method can take into account the variations of internal structure that are to be found in even the most so-called homogenous materials, which variations of structure will always modify the stress distribution to a certain extent.

Simple and Oblique Stresses.

When a body is acted upon by two equal external forces P, such as indicated in Fig. 1, the material resists internally and at any plane section AB there is said to exist a stress; that is, the forces exerted by the smallest particles on one another on each side of the section maintain a condition of equilibrium. What the ultimate composition of these minute particles is need be of no concern for the present; nor need the exact nature of what are called forces acting on and between these particles be determined. It is sufficient to recognize that there is some form of resistance along the plane section which prevents the external deforming action from disrupting the material.

If the external forces P, Fig. 1, are properly applied, it is possible to get a uniformly distributed stress on the section AB; that is, as the name uniformly distributed implies, each unit of area on the plane has the same stress or resistance. The numerical magnitude of the unit stress on a plane subjected to uniformily

distributed stress is found by dividing the total stress on the plane section by the area of the section.

In the majority of cases, it is merely necessary to determine the unit stress or intensity of stress, as it is sometimes called, on a plane which has the stress acting entirely normal to it. Such planes are generally easy to locate, as in most cases they are perpendicular either to a well defined axis of a structural member or they are taken perpendicular to the line of action of an external force which produces the stress.

For instance, if the problem were to determine the unit stress in the material represented by Fig. 1, the natural tendency is to assume that the stress on a plane AB perpendicular to the line of action of P is what is required, and in most cases the assumption would be correct. Indeed the plane along which the unit stress is required is so obvious in most problems that no mention is made of its direction; but, as will be seen with a little consideration, this assumption as to method of procedure is likely to lead to a misconception and disregard of the nature of stress on other planes, if perhaps the existence of stress on other planes is not entirely forgotten. It should be definitely understood that stress exists at all plane sections in material subjected to deforming action. The magnitude and nature of the stresses on the various planes of course differs with the inclination of the planes.

Fig. 1

In order to see more clearly the nature of the resistance on planes other than those having stress acting normal to them, it will be found convenient in all cases to isolate a small rectangular element from the material. Let Fig. 2 represent such an element isolated from Fig. 1, the sides AB and DC of which have a normal unit stress p acting on them as a result of the external forces P. It will further simplify matters if the thickness of this element be taken as unity.

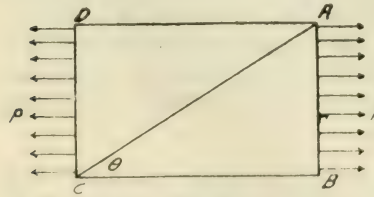


Fig. 2

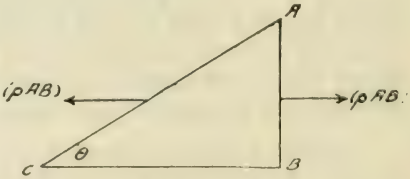


Fig. 3

Consider any plane section CA inclined at an angle θ to the unit stress p. This section need not be taken necessarily from

C to A. Any section will allow the same Algebraic analysis to be applied, but the one taken gives a slightly more concise figure to discuss.

Consider the equilibrium of the portion of material ABC. Acting on the side AB, **which it will be remembered is of unit thickness,** there is a total stress (p.AB). This total stress is represented in Fig. 3 as a single Resultant Force.

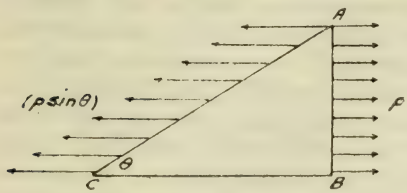


Fig 4

Now since the material ABC is in equilibrium, another force (pAB) must act at some point on CA as represented. But this force acting on CA is in reality the Resultant of a uniformly distributed stress on the plane section CA, of which the unit stress may be found by dividing the total force (p.AB) by the area of section CA. If -r- represent this unit stress,

$$r = p\frac{AB}{CA} = p \sin\theta \quad \text{.....(1)}$$

It is seen, then, that as a result of the uniformly distributed unit stress p acting on AB, there is uniformly distributed unit stress (p sin θ) acting on CA as represented in Fig. 4. This unit stress (p sin θ), since its direction is inclined to the plane CA, is called an Oblique Stress.

The effect of an Oblique Stress is seen more readily if its Resolved Parts perpendicular and parallel to the plane on which it acts are found. In order to determine these Resolved Parts, consider again the total stress (pAB) acting on CA as shown in Fig. 3. The desired Resolved Parts of this total force are shown in Fig. 5. Bearing in mind that these Resolved Parts replace a uniformly distributed stress, it follows that each Resolved Part may be considered as being uniformly distributed over CA and the unit stress of each derived separately by dividing (pAB sin θ) and (pAB cos θ) by the cross section area of CA.

Let x and y be respectively the unit stress parallel and perpendicular to CA

$$x = p\frac{AB}{CA}\cos\theta) = p \sin\theta \cos\theta = \tfrac{1}{2}p \sin 2\theta \quad \text{.....(2)}$$

$$y = p\frac{AB}{CA}\sin\theta = p \sin^2\theta = \tfrac{1}{2}p\ (1 - \cos 2\theta) \quad \text{.....(3)}$$

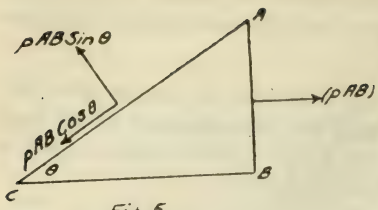


Fig. 5

It will be seen from this that an oblique unit stress on CA may be considered as having two effects. Firstly, a unit stress acting normal to the plane CA of magnitude $\frac{1}{2}p\ (1 - \cos 2\theta)$. Secondly, a unit stress acting parallel to the plane which is equivalent to a shearing stress of magnitude $(\frac{1}{2}p \sin 2\theta)$.

The maximum values of these equivalent normal and shearing unit stresses on CA may be found by differentiating equations (2) and (3). The normal unit stress will be a maximum and the shearing unit stress a minimum when $\theta = 90°$. The shearing unit stress, on the other hand, reaches a maximum value of $\frac{1}{2}p$ when $\theta = 45°$ and it is because of this maximum shearing value that the necessity of discussing oblique stresses arises. It is seen that on planes inclined at 45° to the given unit stress p, there is a shearing effect which gives a unit shearing stress equal to $\frac{1}{2}p$. So that if the material has a shearing strength less than one-half its tensile or compressive strength, failure may take place not by tension or compression, as might be expected, but by shearing on some plane inclined roughly at 45° to the tensile or compressive external forces. This type of failure is quite common in compression tests on brick, concrete and cast iron.

Compound Stress.

In many cases, material is subjected to the deforming action of external forces which give an internal condition that may be analyzed as compounded of two or more stresses on planes inclined to one another.

Planes on which the Resultant stress is entirely normal are called Principal Planes and the Resultant stresses acting on them are called Principal Stresses. Sometimes it will be found convenient, as in the last problem, to take an Oblique Stress and replace it with equivalent Normal and Shearing Stresses. Such equivalent Normal Stresses must not be confused with Principal Stresses. An equivalent Normal Stress acts in conjunction with an equivalent Shearing Stress to produce the same effect as the Oblique Stress they replace. **Principal Stresses, on the other hand, are normal to and are the only stresses acting on Principal** Planes.

In the following, merely three cases will be discussed, namely: a body subjected to two tensions; a body subjected to tension and compression; and a body subjected to tension and shear. In these problems will be found the methods which may be applied to analyze any conditions of stress should the reader have occasion to do so.

Two Tensile Stresses Acting Perpendicular to One Another.

Let Fig. 6 represent a rectangular element of unit thickness of a piece of material subjected to two tensions acting perpendicular to one another and normal to the sides of the element.

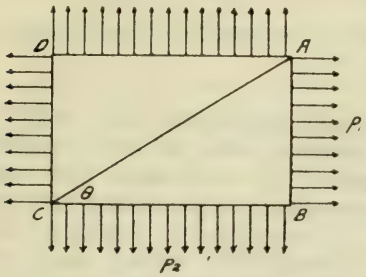


Fig. 6

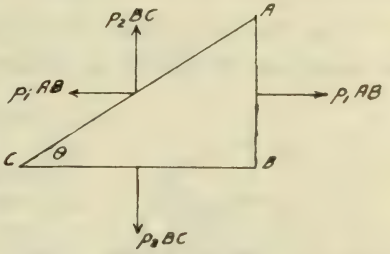


Fig. 7

It is required to find the stress acting on any plane CA which is inclined at an angle θ to the stress p_1.

Fig. 7 represents the total stresses which must act on the portion ABC of the element to preserve it in equilibrium. As in the previous problem, these total stresses are represented as single Resultant Forces for the sake of conciseness.

The Resultant R of the two forces (p_1AB) and (p_2BC) acting on CA is of magnitude $\sqrt{(p_1AB)^2 + (p_2BC)^2}$ and will act in a direction which is dependent on the relative magnitudes of p_1 and p_2. In general, this Resultant will act in some direction other than normal to CA and will consequently give an Oblique Stress on CA. Fig. 8 represents the forces now determined as acting on ABC. Now since p_1 and p_2 are uniformly distributed unit stresses along AB and BC respectively, the Resultant Force R must represent a uniformly distributed stress along CA, the unit stress of which is found by dividing R by the cross section area of CA. Let r represent the Resultant unit stress on CA:

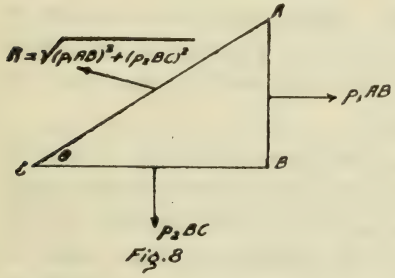


Fig. 8

$$r = \frac{R}{CA} = \sqrt{\left(p_1 \frac{AB}{CA}\right)^2 + \left(p_2 \frac{BC}{CA}\right)^2} = \sqrt{p_1^2 \sin^2\theta + p_2^2 \cos^2\theta}$$

That is, as a result of unit stresses p_1 and p_2 on AB and BC respectively, there will be a Resultant unit stress

$$r = \sqrt{p_1^2 \sin^2\theta + p_2^2 \cos\theta}$$

acting on CA, which in most cases will be an Oblique Stress.

The Resultant Unit Stress may be determined very readily by Graphical Methods, as follows:

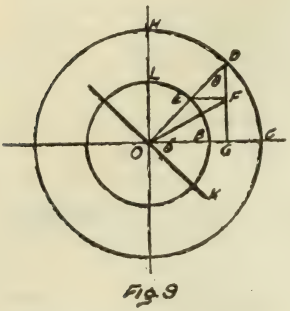


Fig 9

Choose any pair of axes OC and OH Fig. 9 perpendicular to one another. With centre O and radii OC and OB representing the given unit stresses p_1 and p_2 respectively describe two circles. Draw OK making with OC an angle θ equal to the angle of inclination to p_1 of the plane on which it is desired to find the Resultant Unit Stress. From O draw OD perpendicular to OK. From D draw DG perpendicular to OC. From E draw EF perpendicular to DG. Join OF. Then OF will represent the required Resultant Unit Stress in magnitude and direction.

For $$OF = \sqrt{OG^2 + FG^2}$$

$$= \sqrt{OD^2 \sin^2\theta + OE^2 \cos^2\theta}$$

$$= \sqrt{p_1^2 \sin^2\theta + p_2^2 \cos^2\theta}$$

Further, it may be shown that if the Resultant Unit Stress be found for all planes inclined to p_1, the point F in each case will lie on the circumference of an ellipse whose major and minor axes are OC and OL respectively. Such an ellipse is called an Ellipse of Stress. Unfortunately, it is not possible in such short space to go into a discussion of the information that may be obtained from the Ellipse of Stress.

Now, instead of determining the Resultant Unit Stress on the plane CA, it is often found more convenient to derive the Resolved Parts of this stress perpendicular and parallel to CA, finding thereby the equivalent of the Resultant Unit Stress in terms of a Normal and a Shearing Unit Stress. This is best arrived at by again considering Fig. 7 and resolving the forces acting on CA in directions perpendicular and parallel to CA. It will be found easier to do this than to take the Resultant Force

R, Fig. 8, and resolve it in the desired directions, as it would be first necessary to derive an expression for the inclination angle of R to CA which is a somewhat involved procedure.

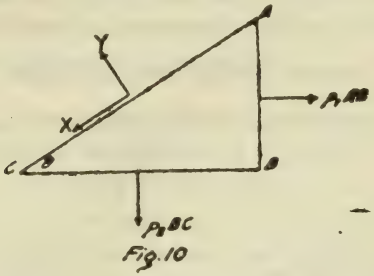


Fig. 10

Let Y and X, Fig. 10, represent the algebraic sum of the desired resolved parts of the forces acting on CA, Fig. 7.

$$Y = p_1 AB \sin\theta + p_2 BC \cos\theta$$

$$X = p_1 AB \cos\theta - p_2 BC \sin\theta$$

But, as pointed out before, since p_1 and p_2 are uniformly distributed, it follows that Y and X may be considered as uniformly distributed over CA. The unit stresses of Y and X may be found by dividing Y and X by the cross section area of CA. Let y and x represent the unit stresses from Y and X respectively.

$$y = p_1 \frac{AB}{CA} \sin\theta + p_2 \frac{BC}{CA} \cos\theta$$

$$= p_1 \sin^2\theta + p_2 \cos^2\theta \quad \text{.....(5)}$$

$$x = p_1 \frac{AB}{CA} \cos\theta - p^2 \frac{BC}{CA} \sin\theta$$

$$= p_1 \sin\theta \cos\theta - p_2 \cos\theta \sin\theta$$

$$\tfrac{1}{2}(p_1 - p_2) \sin 2\theta \quad \text{.....(6)}$$

It is seen now that as a result of the unit stresses p_1 and p_2, there is a Resultant unit stress on CA to which there are equivalent unit stresses normal and parallel to CA whose values are given by equations (5) and (6).

The most interesting case that arises with two tensions such as have been discussed is when p_1 equals p_2. In this case, the equivalent unit shearing stress x becomes equal to zero for all inclinations of the plane CA which may be seen by putting $p_1 = p_2$ in equation (6). This means that the Resultant Unit Stress must act entirely normal to all planes and is of the same magnitude in each case. The ellipse of stress then becomes a circle.

One of the best practical illustrations of material subjected to two tensions as discussed above is the case of the shell of a boiler which is under circumferential and longitudinal tension, which stresses may be analyzed by the methods just discussed.

Compression and Tension Acting Perpendicular to One Another.

Let Fig. 11 represent a tensile unit stress p_1 and a compressive unit stress p_2 acting on a rectangular element normal to the sides as shown.

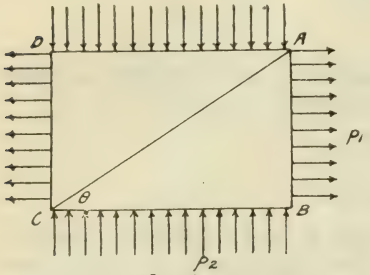


Fig. 11

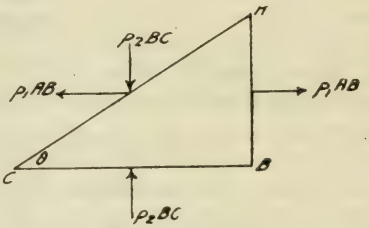


Fig. 12

Following out the same method of analysis in this case as in the last problem, Fig. 12 represents the total stresses which must act on ABC to hold it in equilibrium.

By vectorially compounding p_1 AB and p_2BC which act on CA, the Resultant Unit Stress r is found to have the following magnitude:

$$r = \sqrt{p_1^2 \sin^2\theta + p_2^2 \cos^2\theta}$$

The inclinations of this Resultant Unit Stress r will depend upon the relative values of p_1 and p_2.

Again considering the forces acting on CA as shown in Fig. 12, and determining their Resolved Parts perpendicular and parallel to CA, the Normal and Shearing Unit Stresses equivalent to the Resultant Unit Stress on CA may be found. The method of procedure is the same as outlined in the last problem, care being taken to add the different resolved parts in the proper algebraic manner. If the normal and shearing unit stresses are designed by y and x respectively:

$$y = p_1 \sin^2\theta - p_2 \cos^2\theta \quad \ldots\ldots (8)$$

$$x = \tfrac{1}{2}(p_1 + p_2) \sin 2\theta \quad \ldots\ldots (9)$$

These equations give some interesting results. For instance, if $p_1 = p_2$ and $\theta = 45°$, there will exist only a shearing unit stress

on CA equal to either p_1 or p_2. So that with certain materials, under the conditions of tension and compression as shown in Fig. 11, failure will occur most likely by shearing on a plane inclined at 45° to the given equal tensile and compressive stresses; as few materials have a shearing strength approaching, let alone equal to, the tensile or compressive strength.

Tension and Shearing Stresses Acting Together.

If a body be subjected to shearing action, at any point in the body, there will exist two shearing unit stresses of equal magnitude acting perpendicular to one another. The proof of this statement may be found in any of the references given at the end of the article.

Fig. 13 represents a rectangular element of material subjected to a unit tensile stress p and to unit shearing stresses q as indicated.

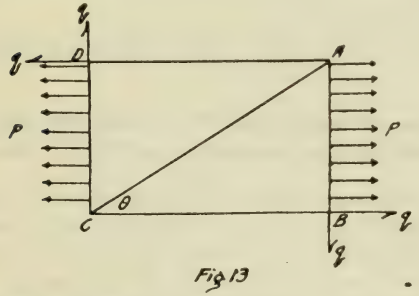


Fig. 13

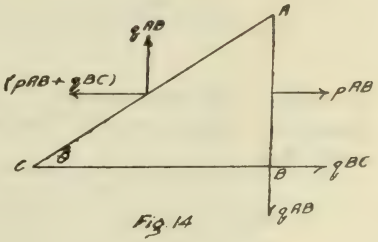


Fig. 14

It is required to find the stress on any plane CA inclined at an angle θ to the tensile stress p.

Considering the equilibrium of the body ABC as in the former problems, there will act on AB a total tensile stress (pAB) and a total shearing stress (qAB); on the side BC, there will act a total shearing stress (qBC). Fig. 14 represents these total stresses as Resultant forces. It follows then that the body ABC being in Equilibrium, there must act on CA the forces (pAB + qBC) and (qAB) as shown.

Resolving the forces acting on CA, Fig. 14, perpendicular and parallel to CA and dividing the Resolved parts by the cross sec-

tion area of CA, the unit stresses y and x normal and parallel to CA are determined as follows:

$$y = \left(\frac{pAB}{CA} + \frac{qBC}{CA}\right)\sin\theta + \frac{qAB}{CA}\cos\theta$$
$$= p\sin^2\theta + q\cos\theta\sin\theta + q\sin\theta\cos\theta$$
$$= p\sin^2\theta + q\sin 2\theta$$
$$= \tfrac{1}{2}p(1 - \cos 2\theta) + q\sin 2\theta \quad \ldots\ldots(10)$$

$$x = \left(\frac{pAB}{CA} + \frac{qBC}{CA}\right)\cos\theta - q\frac{AB}{CA}\sin\theta$$
$$= p\sin\theta\cos\theta + q\cos^2\theta - q\sin^2\theta$$
$$= \tfrac{1}{2}p\sin 2\theta + q\cos 2\theta \quad \ldots\ldots(11)$$

Differentiating these for maximum values, it will be found that the normal unit stress y on any plane CA has a maximum value when

$$\tan 2\theta = -\frac{2q}{p} \quad \ldots\ldots(12)$$

and the shearing unit stress x on any plane CA is a maximum when

$$\tan 2\theta = \frac{2q}{p} \quad \ldots\ldots(13$$

If from (12) the values of $\sin 2\theta$ and $\cos 2\theta$ be omitted and placed in equation (10) the maximum value of y will be found, such that

$$y \text{ max} = \tfrac{1}{2}p + \sqrt{q^2 + \frac{1}{4}p^2}$$

Following the same procedure with equations (13) and (11), the maximum value of x is obtained.

$$x \text{ max} = \sqrt{q^2 + \frac{1}{4}p^2}$$

Thus, if given the unit tensile stress and the unit shearing stress, it is possible to determine the values of the maximum, normal and shearing unit stresses and the inclination of the planes on which these maximum stresses act.

In some cases, it is more essential to determine the planes on which the given stresses produce a resultant unit stress acting entirely normal to the plane; in other words, to determine the Principal Planes. The stresses acting on these Principal Planes will then be Principal Stresses.

Let Fig. 15 represent the total stresses acting on the sides AB and BC of the body ABC. Fig. 13. Required to find the angle θ which will give a Resultant unit stress r acting normal to CA. The total stress acting on AC to preserve the equilibrium of ABC will be (r. CA.). Resolve the force (rCA) parallel to the sides AB and BC giving the resolved parts (rCA) cos θ) and (rCA sin θ) as shown in Fig. 15.

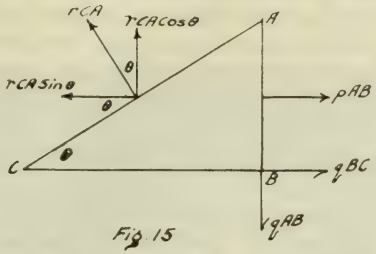


Fig. 15

It is seen that since ABC is in Equilibrium, the following relations must be true:

$$rCA \cos \theta = qAB$$

$$r = q \tan \theta \quad \text{.....(14)}$$

$$rCA \sin \theta = pAB + qBC$$

$$r = p + q \cot \theta \quad \text{.....(15)}$$

Placing equations (14) and (15) equal to one another;

$$q \tan \theta = p + q \cot \theta$$

$$\text{or } \cot 2\theta = -\frac{p}{2q} \quad \text{.....(16)}$$

That is, when cot 2θ is equal to the tensile unit stress divided by twice the shearing unit stress, the plane CA is a Principal Plane and has only a normal stress acting on it.

Equation 16 shows that there must be two Principal Planes perpendicular to one another, for there are two values of angle 2θ differing by 180° for which (16) is true. It follows, therefore, that there will be two planes inclined at θ and (90° + θ) for which the relation is true.

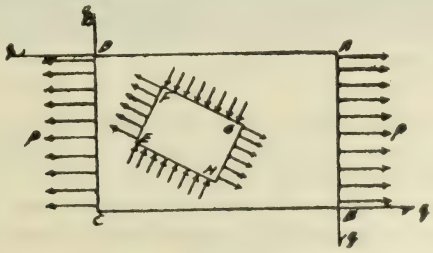


Fig. 16

It is seen from the above discussion that as a result of the given tensile and shearing stresses such as might be found on the tension side of a beam, there are two Principal Planes on which

the stresses act entirely normal. Fig. 16 shows this diagrammatically. ABCD is the given elementary rectangle subjected to stresses p and q, and EFGH is another rectangle which may be determined and on which the stresses act entirely normal as indicated. EF, FG, GH and HE are Principal Planes and the stresses acting on these are Principal Stresses.

In all of the above discussion there has been a condensing of the argument from lack of space to go more fully into detail. Should the reader have occasion to go into the subject more deeply, there will be found in the following references sufficient information with which to solve almost any problem in compound stress:

History of the Elasticity and Strength of Materials—Todhunter and Pearson.
Treatise on the Theory of Elasticity—Love.
Mathematical Theory of Elasticity—Ibbetson.
Mechanics of Materials—Merriman.
The Theory of Structures—Morley.
Applied Mechanics for Engineers—Duncan.

S.P.S.---1878---1891

What Have We Here?

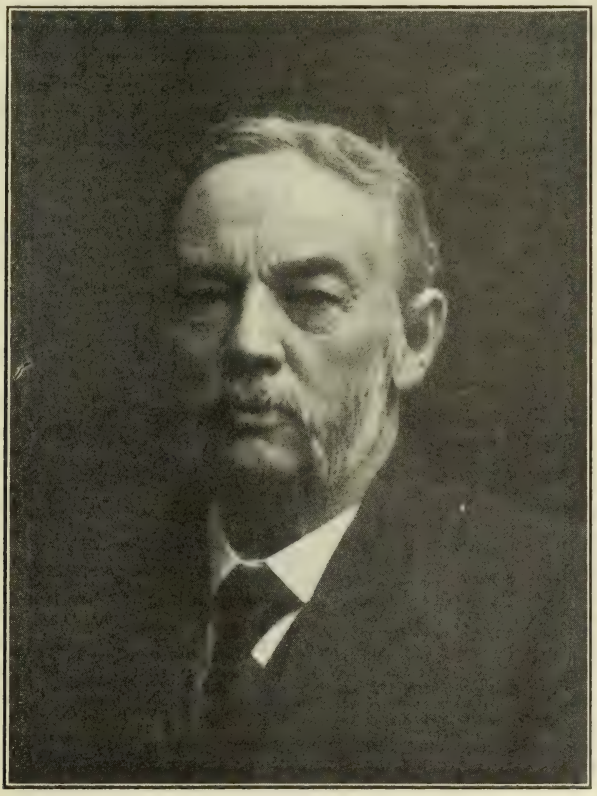
IF the reader chance not to be a School man we beg of him to pass over the few pages which follow, for to such a one they will have no more appeal than has the Calculus to a Freshman.

You who have been initiated into the mysteries of Toike Oike will find in what follows little history and less logic. What you will find depends somewhat on you. What you may find is the spirit of the Old Red School.

What freshman is there who would not enjoy being present at a reunion of the very first "grads." of School; not a fussy, formal affair with toasts and speeches, but a pipe-smoking, feet-on-the-hearthrug occasion, with a reminiscent feeling in the air, everyone feeling free to say what he pleased about old times, and everybody , everybody else's best pal. Wouldn't the "Old Guard" themselves enjoy such a meeting? This is the atmosphere we have tried to create. We have asked a number of our early graduates to spin a few yarns. We have endeavored to make our own part simply that of the host who passes the introductions around. Apart from that we have added

here and there the barest outline of facts in order to indicate the relation of the various parts.

We make no pretence at completeness. The very nature of our experiment precludes that. To those who have responded to our appeal to write something for the following pages is due all the credit for any pleasure or interest that may be derived from their perusal. These are busy men in



"JOHNNIE"

the forefront of the engineering and business world, yet they still have interest, enthusiasm and time to spare for the Old Red School.

The College of Technology.

In 1871, in a brick building on the corner of Church and Adelaide, occupied by the Mechanics' Institute, at present by the Public Library, evening classes were started for working men,

in engineering subjects. The staff consisted of Mr. James Loudon (late President of the University), Instructor in Mechanics, Mr. W. H. Ellis (late Dean of the Faculty of Applied Science), Instructor in Chemistry, and Mr. W. Armstrong, C.E., Instructor in drawing.

School of Practical Science.

During the following six years the subject of engineering education was buffeted about in the political arena until in 1877 emerged the first installment of the "Old Red School." This was the north wing, and did not include the room now used as supply department or anything farther south. When the name of the new institution was under consideration, Mr. Galbraith, in correspondence with the Minister of Education, said: "What ever you do, for Heaven's sake don't call it the School of Practical Science." The Minister's reply was in substance as follows: "I have decided to adopt your very excellent suggestion that the new institution be called the School of Practical Science." And so the School of Practical Science it was and is, in spite of recent official attempts to change it, and I suppose always will be. Because the word "School" has acquired a charm for her sons which the "Faculty of Applied Science and Engineering" can never have.

The Red School.

When the School opened in October, 1878, the Engineering Department, under Professor Galbraith, occupied a part of the second floor of the building, viz.—a small private room, now nuber 36, a library No. 34, and a drafting room No. 33. A lecture room, now numbered 35, was shared in common with University College, while the remainder of the building was monopolised by U. C. for the Departments of Mineralogy, Geology, Biology, Botany and Chemistry. In those days, S.P.S. Students received instruction from U.C. in Mathematics, Physics, Chemistry, Mineralogy and Geology.

Johnnie.

Now that we have seen the School established in its present home, we may well turn aside to pay tribute to a man who was the Father of the School, whose life was devoted to its service, who was at first the entire staff of the School, who was the very embodiment of the Spirit of the School. J. Galbraith, M.A., Gold Medalist in Mathematics, Professor of Engineering; to his students—"Johnnie." One has only to talk with a few of his students with whom he came into personal contact in those early days to realize what a tremendous influence he exerted

over their lives. Mr. E. W. Stern, '84, speaking at the unveiling of the late Dean Galbraith's portrait, said in part:

"His (Galbraith's) technical qualifications and breadth of view were such that we soon realized we were under the guidance of a master mind. It was, however, the human quality of the man, his fineness, his way of thinking and talking straight, his kindliness and interest in each of us and his sympathetic nature, which appealed most to us. He was a man every inch of him, and one of nature's own noblemen. He never preached at us, nor did he ever talk about what was right or wrong, but somehow or other, remarkable to say we absorbed ethical teaching from him. I have spoken to many of our graduates and they all agree with me in this:—we seemed to feel what he thought was the right thing to do. We, his old pupils, are his life long friends. We owe him a debt which can never be repaid."

Mr. T. Kennard Thomson, D.Sc., grad. of '86, writes in response to our queries: "Nothing could equal the inspiration the early graduates received from Principal, afterwards Dean, Galbraith, and without any qualifications at all, that was by far and away the most outstanding feature of the Red School House."

Mr. T. R. Deacon, '91, wrote on the occasion of the Dean's death: "He has left his mark in Canada through his great influence. He was beloved and revered by every student who studied under him, and few men will be more widely mourned."

These spontaneous tributes, which could be continued almost indefinitely, require no comment, except that we quote in conclusion from Applied Science, July, 1914.

"The School will always mark the life of our late Dean in the pages of history, and if we are true to the debt which we owe him, we will not allow the growth of the School to be stunted, nor the union among School men to be weakened, but will converge our energies toward keeping bright and prominent, the monument of his building."

Dean Galbraith, besides being a scholar of most extraordinary brilliancy and versatility, was a great pioneer. When the Fenian Raid broke out in 1866, he was engaged with Mr. Stewart, Prof. L. B. Stewart's father, in surveying the North shore of Lake Superior. When the news of the war reached them, they decided that one of them should go, and to settle which it should be, they wrestled. Mr. Galbraith was the winner and crossed Georgian Bay in a birch bark canoe, but did not arrive till the raid was over.

James L. Morris, '81.

The first man to receive the Diploma of the School of Practical Science (no degrees were granted in those days) was Mr. James L. Morris. Mr. Morris, who has a large general practice in Civil Engineering in Pembroke, has been kind enough to write something for us of his undergraduate experiences, which we quote herewith:

"When a boy of about fourteen years of age, and seeing the Engineers at work on the construction of the Canada Central Railway at Pembroke, my inclinations turned towards the Engineering Profession. On making inquiries as to where an Engineering training could be secured, practising Engineers were able to give me little or no encouragement except to begin as a rod man or picket man on a Survey.

"I saw in the University of Toronto Calendar where a two year Engineering course was given and securing requirements for matriculation, managed to present myself for examination in the fall of 1878.

"In September of that same year, Alfred Baker, then Registrar of University College and Secretary of the School of Practical Science, said: 'For this two year course you will have to get your lectures the best way possible, but there is a new Engineering Course starting in that red brick building across the lawn, you had better find out about it before registering.'

"Professors Chapman, Croft, Wright and Galbraith, were the names of the staff, judging from the plates on the doors, but nothing positive could be found out about an Engineering Course until John Galbraith, Master of Arts, (Toronto), one time practising Land Surveyor near Port Hope and Assistant Mechanical Engineer for the Portland Locomotive Works, Portland, Me., and at this time the whole of the Engineering Staff, took hold of the matter himself and got the first class of the School going. That class was Clarence Galt, George S. Hodgins, Craven Ord, Gray, John McAree, and James L. Morris.

"The names of School men were prominent at the October sports of the College, in the mile, half mile, steeplechase and walking race in 1878-79 and '80. At this time all sports were held on the lawn lying between University College and the School.

"The Literary and Scientific Societies also heard from the students of the S.P.S., who listened with interest to the readings, essays and speeches of J. D. Cameron, W. T. Herridge, and R. Y. Thompon, all Arts men, for there was practically none but Arts men at that time.

"The Literary and Scientific Society passed a by-law in the winter of 1879, making all regular students of the School of Practical Science eligible for membership in it.

"As the Government did not supply any instruments for use by the S.P.S. students in 1878-79, Professor John Galbraith produced his own transit to open up the wonders of the firmament to the whole School of six. It was on the lawn, about midway between the School and the Meterological Building, which then stood on the ground immediately east of the Physics Building. It had been explained, the transit levelled, turned on polaris, the lantern lighted to illumine the cross hairs, the exact time of elongation determined, and yet thirty minutes to spare. After midnight, all was quiet, and why not leave the transit and adjourn to more comfortable quarters. Thirty minutes later there was no transit and no one in sight. A hurried council decided that it probably was in the room of a residence man. Two days afterwards a thoughtful member of the Meterological Staff, remembered that he had found a transit in the early hours, and made inquiries. It is not on record when this first observation was completed.

"At Christmas, 1880, Professor Croft retired from active work and Professor Pike took his place.

"The Easter Exams. showed that 64 out of 65 students knew nothing about Chemistry. The writer was one of the 64. With a high percentage in all other work in the 2nd Year Engineering and a prize in sight but for Chemistry. Prof. John Galbraith arranged a meeting of the Second Year in Civil Engineering, Professor Pike and himself. A special Exam. in Chemistry was held right there and then and it was declared that the text-books were to blame, and that is how one prize was given in the Engineering Department in 1880.

"From 1880 until 1886, no S.P.S. student other than a prize man ever passed in Chemistry, nor was a supplemental exacted. Looking into the Architectural Exhibit Room, in the East end of the second floor of the old School Building, I recognized the old draughting room of 1881. It did not look familiar. The old rope elevator was not there. That elevator passed and repassed through our room during lectures, and not until a Freshman of 1873, who knew all about tackle in yachts and Rugby came to the School and saw the trouble, did a solution seem probable. He walked over to the elevator, twisted the rope around a post of the rail, and then everything was quiet

for a time, until the Chemical Department found out where the trouble lay and started that cry, 'The School of Science Man.'

"This was the first attempt of School men to assert themselves as part of the forces of the University."

Jas. H. Kennedy, '82.

At this point we hand over the narrative to Mr. Jas. H. Kennedy, who is chief Engineer of the Vancouver, Victoria, and Eastern Ry., and Honorary President of the Pacific Coast Branch of the Engineering Alumni Association. Mr. Kennedy writes:

"I have your letter of the 14th inst. asking me to write something about my undergraduate experience that may be used as some help in the preparation of a story made up of fact and fiction, that will give the boys some espre de coeur or whatever you call it; now, so if I can help you with some facts you may be sure to supply the fiction, so it will form a chemical combination of gas. I presume natural gas is what you are after.

"Well the School opened in 1878, though I did not reach it until 1879. Now, I don't know how many students attended during 1878, but as near as I can recollect now, there were but two students—J. L. Morris and John McArree. There may have been others, but they must have been specials. Jimmy Morris took the full course and headed every class without difficulty. He was also quite an athlete and held his own well at the annual games against the Arts men. I think he took several prizes for running. He could run like a steer in a cornfield. The other student of 1878, Mr. McArree, was a land surveyor of more advanced years, a widower with, I think, four children. He did not return for the session of '79, but returned during 1880, and was in my class until he and I graduated together during 1882, and I have never met him since. He died in Toronto, I believe, several years ago.

"The class of '82 were Donald Jeffrey, John McArree and yours truly. There were two others who did not try the exams, David Burns, who joined a later class, and J. H. Shortt, whose principal defect was color blindness, and he had to be told the color of his ink. He never graduated so far as I know. So you see that the class of '82 was as a matter of fact the three graces, or rather the triumvirate, greater perhaps than the triumvirate that once ruled Rome, if you take into account the amount of dirt we have moved in the last forty years. Donald has stuck to contracting and I to railway engineering, and we have not been upon the some work since 1893, when we met on the Soo Line in North Dakota. Possibly this is enough along this line.

"Now I see you wish to know the spirit of the School. Well the prevailing spirit in '79 was the mischievious spirit of having fun with the Toronto police. Some students of the Arts classes

went to the opera one night and returned up Yonge Street in procession and singing college songs, when the police objected. Very soon it became the habit to sing every night, and pretty soon the fashion developed of carrying quite heavy hickory canes, that kept time as they came down upon the sidewalks in time with the step and the music. Pretty soon a students' union was advocated, and the students of all colleges were advised to attend at a meeting in the old Temperance Hall on Temperance Street. Some 1200 were in attendance. Dr. Montague was called to the chair and the Students' Union was launched, with the avowed object of purchasing books at a discount. After the meeting a procession of at least 1200 formed and marched up Yonge Street, singing and wielding the canes, to Bloor Street, which was the northerly limit of the city. When all had crossed Bloor Street, the police stopped. The police did not cross the street, but lined up on the south side and the students upon the opposite side. It was then that E. P. Davis, an Arts man, now a lawyer in Vancouver, was hoisted upon the shoulders of other students to address the police, and it was done in E. P.'s best style. Regret I cannot recollect what was said, as it would be well worth remembering. Several students, I believe, were arrested upon their way home, among the Medicals, but a collection was taken up the next day and their fines paid. I do not recollect anything of the students' union after that night, and the fun with the police died out shortly after that.

"You ask for our year yell. Well, we had no yell specially fitted to our year in '79, but we shared to some extent in the general howl caused by the advent of Professor Pike to the Chair of Chemistry. Now, during the first term of '79 Professor Henry Croft lectured on Chemistry in the westerly room in the old School to students from all faculties of the University, and the dentists, veterinaries, medicals, etc. Professor Croft was a tall, slim man, who wore spectacles and whiskers and had a great reputation as a chemist, but new blood was wanted, and Professor Croft was given an address and a farewell, and Professor Pike, an English dude who had finished up in Germany, appeared in his place. Then we learned that 22.4 litres of any gas would give its molecular weight in grammes, and we never forget it. However, Professor Pike plucked every son of a gun in every faculty in the School and the University, and that is where we got the howl for all years and our '79 howl was the same. I have special personal reason for remembering that exam, as Professor Pike made a mistake and gave us a paper on other work that we had never studied, and I gave only one reply to one question. Soon after I was summoned before the authorities ties for giving an impertinent answer, which the Professor said was to be a pretty serious matter to me. However, through the good offices of our Johnny Galbraith, I was not hanged.

"Johnny was a good friend to have in those days. It is only fair to say that I now believe Professor Pike proved that he was a tower of strength to University College and to the old School.

"Well, we had no other yell during my time, and if the Toike Oike had appeared we would have taken to the tall timber no doubt.

"About that time appeared to be a transition time in the faculty of University College, as not only was Professor Croft retired, but Dr. Daniel Wilson, the president, died soon after. Sir Daniel Wilson was a renowned man in his time. A tall, slim man, who wore his high plug hat on the back of his head, wore long hair and somewhat stooped and always walked in a hurry, always reminded one of the picture of Uncle Sam. The two men who were head and shoulders above all others at that time were Dr. Wilson, and Professor George Paxton Young, who taught metaphysics, into whose classroom we often slipped very quietly for a treat. Now, if you can get anything tangible out of this you are no doubt a daisy."

For our part, we shall not try, being content with the intangible.

Prof. W. J. Loudon gives the following account of student life during this period:

"In those early days, in fact until the date of the University fire, in 1890, there were few buildings in Queen's Park devoted to education, and the western side of it, surrounding the University, was more or less of a bush, intersected by a ravine extending from Bloor Street to College Street, through which ran a little stream, The Toddle, where freshmen were baptized every Fall by their seniors. The gymnasium was merely a room in a cellar of the old Medical Building that occupied the site of the present building for Biology. Most of the students preferred a walk in the open air or a little game of association football to a turn in the gymnasium. Walking, probably, was the most popular form of amusement and exercise, being both cheap and invigorating, and the highest form of sport was a walk to Hamilton in company with congenial friends. The theatre, as it always will be, was a great attraction to the students of the period, 1878-'90, especially as that decade was a golden one in Toronto for legitimate plays, and it would take pages to give the names of the great actors and actresses who appeared during that time, and of the Shakesperian plays, comedies, melodramas and operas presented in the two theatres then existing in Toronto before audiences packed to the roof. You would be sure to see, therefore, any Friday night or Saturday matinee, groups of students scattered about the old Lyceum or Grand Opera House, waiting expectantly for the curtain to roll up—when numerous enough singing snatches

of college songs, much to the delight of the audience, occasionally overstepping the bounds of propriety, always, however, ready to applaud to the echo the efforts of the great men and women who appeared on the stage.

"To the student of that day, trained in simple habits, without the phonograph, movies, automobile, when even the electric light and telephone were luxuries, such a treat as a Shakesperian play constituted a great privilege and was a real education. There was no residence for Science students, the existing one, which formed the western wing of the Main Building, being used only for students in Arts. But board and lodging were easily obtained and prices were low, from two to three dollars a week being the average charge. There was practically no supervision of the student; he did what he liked as long as he attended a good proportion of his lectures. Sometimes this was a bad thing—usually a good thing, as it encouraged independence and self-control.

"Comparisons are odious and it would be futile yet to compare the past with the present; but one feature of the daily life of the student of bygone days stands out in bold relieef, namely, the personal contact with his fellow-students and teachers; they all knew one another, not casually, but intimately; inquiry was encouraged as well as interchange of opinions. So that very slowly, but surely, there was laid in each student's mind the foundation of that which is more important even than education—personal charactere."

G. H. Duggan, '83.

The only graduate of '83 with whom we were able to get into touch was Mr. G. H. Duggan, D.Sc., President and Chief Engineer of the Dominion Bridge Co. Mr. Duggan writes as follows:

"I am in receipt of your letter of February 9th, and sympathize with your campaign to keep the traditions of the School before those who now have, or who have had, the privilege of falling under those traditions.

"I am trying hard to straighten out my affairs so that I may leave the end of this week for a month's cruise in the Caribbean, and regret that, in consequence, I shall be unable to assist in your work. The only consolation is that those of the very early years were too few in number to have made any traditions for the School or to have much to recount that would be of interest. If my memory serves me correctly, only three graduated in our year and our School life was of necessity mingled with the other faculties of University College."

E. W. Stern, '84.

Having tried to get into touch with Mr. E. W. Stern, '84, and failed, we take the liberty of quoting from his address on the

occasion of the unveiling of Dean Galbraith's portrait:

"It was then (1881) a very modest school, only three students in the third year, three or four in the second, and about one dozen of us freshmen. The faculty in engineering consisted of Prof. Chapman, Dr. Ellis, Dr. Pike, and Prof. Galbraith, and we had a few hours a week in University College under Profs. Loudon and Baker. All the engineering lectures were given by Prof. Galbraith, as well as the field instruction in surveying, and for three only too short happy years, he led us all the way through the mysteries of mechanics, thermodynamics, descriptive geometry, hydraulics, etc.

"He was not only popular with us, his students, but he was appreciated by all sorts and conditions of men. The Ojibwa Indians call him by a name which means 'The Little Chief with the noonday face.' I recall personally a suggestive incident bearing on this phase of him. Twenty-six years ago, during

Dean Galbraith Camping with Indian Guides.

my summer vacation, I was on a surveying party in Nipissing; one night our party were encapmed neear a Hudson's Bay post called Fort McLeod, at the mouth of Sturgeon River. In talking with the factor, whose name I cannot just now recall, he asked

if I knew a little professor from Toronto—John Galbraith by name. I told him that I did know him and that I was then studying under him. He said to me: "he is the finest man I have ever met; he tells the best stories,—I would like him to visit here again," and we drank the professor's health from a black bottle and, thanks to him, I slept in a bed that night, the first in four months.

"There were five of us who graduated in the class of 1884, a striking contrast with present times. I shall never forget his farewell address. Calling us together, he told us that now having completed our course at the School, we must start in the world with the idea in our minds that we knew nothing whatever about engineering, and should commence our practical work at the bottom. It was characteristic of the man's modesty and thoroughness; never was better advice given, for we started out in the world with no false notions of our importance, and worked our way up gradually without friction."

"Those of our younger graduates whom I have met in recent years as well as the older ones, have nearly all appeared to me as having some certain characteristics in common, namely, thoroughness and modesty. I know of none who have been failures in life."

The Engineering Society.

The year 1885 may be marked without fear of contradiction as being the red letter year in the history of undergraduate life in the School, for it was in this year that the Engineering Society came into being. We are very fortunate in having the story from the father of the Engineering Society, Dr. T. Kennard Thomson, who is now a consulting engineer in New York city. This is what Dr. Thomson says:

"In 1885 the late Herbert J. Bowman suggested that the S. P. S. boys should have an exhibition at the annual University Conversazione, so we got together and rigged up an Engineers' Camp with transits, levels and other implements of scientific labor, artistically arranged outside. The Camp was made realistic by means of some pine trees, and plenty of cotton batten for snow, to say nothing of a dummy made by artistically stuffing

T. Kennard Thomson.

straw into an old suit of my corduroys, which dummy made a great impression on the lady visitors from the pathetic manner in which he was reading a letter from home while reclining on the ground.

"I have never heard whether this camp feature was ever repeated or not.

"About that time, I suggested forming an engineering society, but was told that the third year men had taken the matter up very carefully the year before and had finally decided that it would be absolutely impossible to start such an organization in such a young school.

"So I apparently dropped the subject for a few weeks, but being young and ignorant, did not realize that as there were at that time only twelve graduates of the School, that of those who were at college only sixteen would graduate, the time was hardly ripe for such an undertaking. So I invited Principal Galbraith and Dr. Ellis and the entire class of 1885 and 1886 to take dinner with me about three weeks later. To enliven the meeting I also invited the now eminent Attorney David T. Symons of Toronto, and my old red-haired room-mate of Upper Canada College days, whom I knew as 'Gooie,' but who was the eminent Dr. James D. Thorburn when he died some years ago.

"Incidentally I have never known a red-haired man or woman who was not amply supplied with brains and energy and humor, and J. D. T. was no exception to this rule.

"After the coffee I gave my guests the first intimation as to why I had taken the liberty of inviting them to the house of my sisters and myself, by getting up and suggesting that we co-operate and organize an engineering society. Fortunately Principal Galbraith, who had so kindly accepted the invitation, with his unfailing kindness of heart, at once got up and made a speech which ensured the success of the entire project. A committee was at once formed to draw up a constitution.

"It is true that the society has had its ups and downs, but its recuperation from a few setbacks and marvellous step forward in each case has been a source of unfailing pleasure and gratification to me, as it is always a pleasure to start something going and see each successive leader going farther than his predecessors.

"In the early days we did not dare risk anybody but Principal Galbraith for President, but he finally insisted upon retiring when he was able to turn over the reins to such a capable successor as Haultain, now the distinguished professor.

"It would be hard for me to find anything in the engineering line which I am so proud of as I am of my connection with our Engineering Society. You will notice the only qualification I put in the above sentence was in the two words 'Engineering line,' and you will understand this qualification when I remind you that I married a Toronto girl and have five children."

The organization committee was as follows:—

President—Prof. J. Galbraith.
Secretary—T. Kennard Thomson.
3rd year rep.—B. A. Ludgate.
2nd year rep.—J. R. Gordon.
1st year rep.—J. C. Burns.

We continue to quote from Dr. Thomson's letter.

"In answer to your question as to why the class of 1886 surpassed that of any other year, I say that it was because A. M. Bowman, E. B. Herman, Robert Laird and Henry Gratton Tyrrell were the brainiest and finest bunch of boys (they have lived up to their reputation ever since) that was ever turned out of any school. But I would like to apply the same remarks to all the graduates and special students from J. L. Morris of 1881 to Professor C. H. C. Wright of 1888, as there are only two in all that number whom I have never met. I had frequent correspondence with those two as well as all who graduated before me.

"Not having known all the men of the later years, there may or may not have been an occasional "lemon" in each year, but I am ready to contend with anyone that there were no "lemons" among those who graduated before me or were at college at my time, and I have kept track of most of them ever since.

"I remember that one of my classmates, who had spent a marvellous summer surveying on the prairies, fell asleep during a mathematical lecture. Of course Professor Baker realized that no one could fall asleep during his illuminating lectures, and when he saw my classmate's head drop forward, realized that he had fainted, and asked me to escort him to his boarding house, which I did with pleasure. By the time I walked to the other side of Yonge Street, he had quite recovered from the change of air and diet.

"Once I walked up Queen's Street Avenue, now University Avenue, with one of my classmates, when a young girl ran up from behind, gave him a hard slap in the face, and then dis-

appeared. This struck him so funny that he stopped in the middle of the sidewalk and laughed until he nearly had hysterics before I could get him to move on.

"In my time there were so few of us and we were all such hard workers that we had no time for anything, excepting a few scraps with the Medicals. Nor did we have the time or brains to invent a yell, and the first time I had the great pleasure of hearing the 'Toike Oike' was after a lecture before the Engineering Society of McGill University, when they honored me with a real 'Toike Oike' yell in great shape."

THE first publication of the Engineering Society appeared in the year 1887. It consisted of a forty-three page booklet containing seven papers read before the Society, mostly by undergraduates, during the session 1885-86. The publication of these papers was continued annually until 1908, when "Applied Science" put in its first appearance.

We happen to have a prize list of the year '88 in which we note with interest that the name at the top in twelve subjects out of fifteen, is C. H. C. Wright. The three subjects in which he had to be content with second or third place were chemistry, mineralogy, and essay. In the second year T. R. Rosebrugh headed the list in every subject in which he was a candidate, with one exception. In the column headed drawing, T. R. Rosebrugh appears, sad to relate, at the wrong end of the list. We are very sorry that Prof. Rosebrugh's health has necessitated his going south for the winter, and consequently we have been unable to approach him on the subject of his undergraduate reminiscences. Prof. Rosebrugh was appointed to the staff in 1890, being the third appointee in the Department of Engineering. It is our sincere wish that he may be with us again during the coming session, fully restored in health.

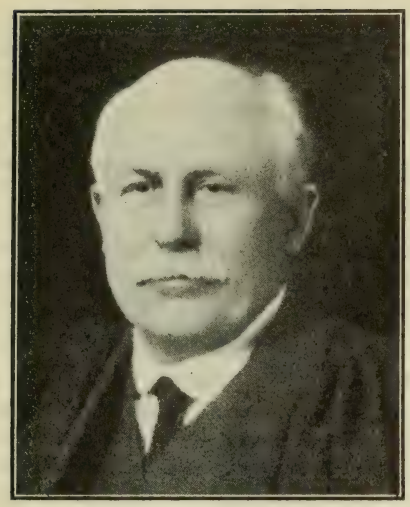
During the session 1887-8 the general committee of the Engineering Society was as follows:

President—Prof. Galbraith.

Vice-President—C. H. C. Wright.

Secretary-Treasurer—H. E. T. Haultain.

Corresponding Secretary—G. H. Richardson.



C. H. C. Wright.

PROF. C. H. C. Wright has continued all his life in the front rank of all School activities—academic, athletic, political, Y.M.C.A., social, military—and if we have omitted to mention any fields of endeavor connected with the School, no doubt he has been foremost in them too. We hope that in the future he may find time to put in writing some of his intensely interesting memories of School, and for the present we are indebted to him for the stirring description which follows, of student life during his undergraduate days.

Early Initiations.

"It was an established custom within the University for a special committee of the senior students during the first two weeks of the session, to investigate many suggestions and conclude in most cases that the member of the first year was too fresh and must be arrested and brought before the "Mufti." On the appointed afternoon the royal guards seized the victims and locked them up in some obscure room in the basement of the S.P.S. or W.C. About ten o'clock a procession of students was formed up and proceeded on a tour of inspection of the grounds, led by the "Mufti," the Council and the guards with their prisoners blindfolded. Everything proving satisfactory, the "Mufti" ascended the throne on the terrace near the main tower and, surrounded by his Council, proceeded to try the various prisoners. They were sworn in by the bones of Sir Daniel Wilson (President of the U. of T.), and at the close of the trial took a solemn oath to treat all senior students with respect, to abstain from wearing gloves, or hard hats, carrying canes, etc., and generally to assume a humble attitude. Every prisoner was furnished with legal advisers (senior students), who might plead anything from a head bursting with the ability of genius to insanity. In such cases the Meds would be called in to examine the head in question and report. After a most thorough examination with running comments, a conclusion would be arrived at such as: "I find here, sir, a well balanced head, nothing in front and nothing behind." Thus from start to finish (usually daylight), the meeting would be punctuated by roars of laughter.

"If the prisoner failed to answer the questions to the satisfaction of the Council or to humble himself as becometh a freshman —"an insect"—"it," etc., some form of torture would be applied and might range anywhere from the shaving of part of his moustache, to a trip down the River Toddle on his back.

"During the Autumn of 1885, a freshman by the name of Coil was locked in the basement of the School in preparation for the hazing ceremony. When things became quiet and the guard small he, having found an axe, smashed his way to freedom, taking care to help all others similarly situated, and at the same time do all the damage possible in a short time. The following day this could not be overlooked and as a consequence the caretaker was dismissed and "Prof." Graham appointed in his stead.

Elections.

"There were interesting elections in those days, but they were those of the Arts Society, i.e., the Literary and Scientific Society, in which S.P.S. regular students were eligible for membership. Most School men, however, were satisfied that the Engineering Society was sufficient, and did not join during the session. They were then the legitimate prey for the corruption committees of the two Lit parties. They were invited to attend the annual elecions and were usually driven in a cab to the hall. There they were met by the two brute force committees (Varsity athletes), stripped to the waist and kept covered with vaseline, whose duty it was to pass the candidate on to the polling booth or keep him out, according to instructions. The Lit regulations provided for the closing of the poll as soon as five minutes passed without a vote being polled, thus during the early part of the evening it usually required four minutes for a candidate to pass the B. F. committee and be pushed through the door to appear before the returning officer. Here every School man was required to undergo an examination and answer such questions as: Your name? Factulty? Who is Johnnie? Who lectures to you in Math.? What does Alfie look like? What does he think about S.P.S. students? Are you a member of the Lit? If not a member then how did you get here? One of the scrutineers would then hand the Treasurer of the Lit the fee ($1.00) from the corruption fund of the proper party and proceed to mark the ballot, thus saving the candidate any further trouble. Then came the refreshment room, with its tables burdened with crackers, cheese and beer, and other liquids.

"In 1878, when John Galbraith assumed his dutiese as Professor of Engineering in the Old Red School House, he was disappointed that there was neither equipment nor even accommodation for any engineering laboratories in the new building recently erected by the Government for the School of Practical Science. For ten years, while struggling hard with all the engineering subjects of all years on the calendar, developing and delivering

the various courses of lectures, he continued to point out to the Hon. the Minister of Education (G. W. Ross), that if he ever expected to develop the Province of Ontario he must provide the means for educating the coming generations of engineers. At last, in 1888, Prof. Galbraith was requested to accompany Dr. Ross on a visit to the Engineering Schools across the line. The result of this visit was the erection of the southern portion of the present Engineering Building and the equipping of its laboratories on a scale that was then considered very liberal.

"Thus in 1890 with the new building containing modern engineering laboratories, with an enlarged staff and the control of the institution entrusted to a council composed of the S. P. S. staff, the School made a fresh start towards an ever widening field of usefulness. Prof. Galbraith, now Principal Galbraith, appreciated this reward of his untiring efforts, and with this stimulus immediately mapped out for himself and his staff newer, broader, and higher standards that his School and his boys might be acknowledged as good as any, if not a little better.

"Research work in Canadian materials and the methods of their uses was encouraged and started as soon as the equipment in the various laboratories was installed. Thorough investigations comparing the values of Canadian and imported building materials and products were started. As a direct result of these researches the engineering and architectural professions were furnished with many constants that enabled them to use Canadian goods intelligently. The Toronto press was naturally interested in these practical tests, and published many readable descriptions of the work of "Johnnie" and his laboratories. Thus not only the profession but the public gradually gained a confidence in our locally manufactured building materials that has not been shaken since.

"It was not long until the Government of Ontario was fully satisfied that the money spent on the S. P. S. was a good investment for whenever they or any municipality or private organization in the Province had a difficult engineering problem, there were sons of Ontario equipped and ready to solve it. Not only then was "Johnnie" proud of his boys, but the Hon. the Minister of Education and the Premier of Ontario were too.

"Thus during the first twenty years of the School's struggles for recognition, the students and their engineering society, the staff and council with "Johnnie" as a leader, fought hard, shoulder to shoulder, and it is no wonder that there grew up a bond of union, a fraternal spirit that has lasted and will last as long as time. "Service, Truth and Honor" was his motto, and while he never published it, he lived the part and expected the School to act accordingly, with the result that the banner of the institution, untarnished, is carried high by a large number of distinguished graduates from coast to coast and even to the uttermost parts of

the earth. Today the sun never sets on the Little Red School House.

"When the hinterland of Ontario had to be explored, S.P.S. men were ready to stake out the lots or claims—ready to build lines of communication—ready to push the frontier back to make it more habitable and increase its output—ready to burrow beneath its surface and bring its treasures to light, and ready to utilize its water powers. Finally, they have solved the old riddle, "What would happen if an irresistible force met an immovable body?" Have not the stalwart sons of the School harnessed the irresistible Niagara and distributed its blessings of power, light and heat to the multitude living in Southern Ontario?"

IN the year 1888 a radical departure was made in that the Engineering Society had a student president for the first time. The general committee was now made up as follows:

Pres.—H. E. T. Haultain

Vice-Pres.—T. R. Rosebrugh

Sec.-Treas.—J. Eaman

Cor.-Secretary—F. X. Mill

—all undergraduates at the time.

H. E. T. Haltain

Prof. Haultain says:

"'Johnnie' always insisted that the Society should be run entirely by the students. 'Johnie's' advice to us was: 'Run the Engineering Society yourselves.' When that principle has been departed from generally there has been trouble."

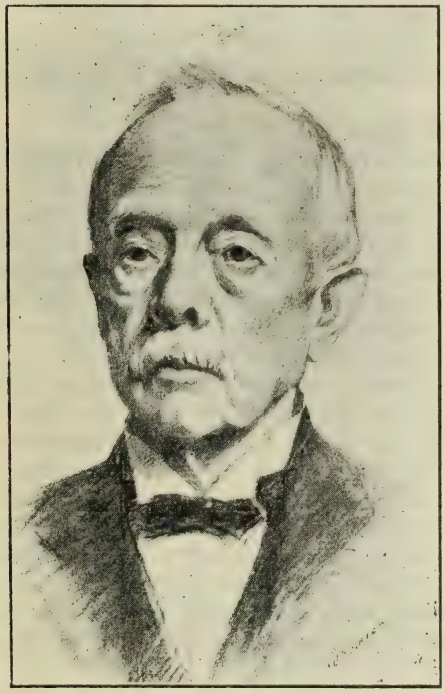
Prof. Haultain was a freshman in '86. He says the prevailing form of initiation for freshmen in those days was to bring them up before a court for trial, each individual case being tried strictly on its merits. This method of initiation seems to have dropped out of use about 1888. Tapping was quite a regular form of punishment. The second and third years used the same draft-

ing room. The bill for window breakage in that room during one term was $58. This is striking evidence of the fact that even at this early period, class spirit had reached a high state of perfection.

Prof. Haultain started a library for the Engineering Society, to which volumes of engineering publications were contributed by Col. Gzowski. The first volume to be bought out of Engineering Society funds was Rankin's "Civil Engineering." The fact was brought out very strongly by Prof. Haultain that the late Dean Galbraith was the dominating influence in the early days of the School.

A very picturesque figure at the School at this time was "Prof." Graham. "Prof." Graham was appointed caretaker in the Autumn of 1885. He made drafting boards, which he sold to the students, and every night at the appointed hour he uttered the momentous dictum, "five o'clock, gentlemen." It was the custom for the students to give him a Christmas present, and on one such occasion he was presented with a greased pig, which he was forced to pursue through the building for some time, much to the amusement of the onlookers.

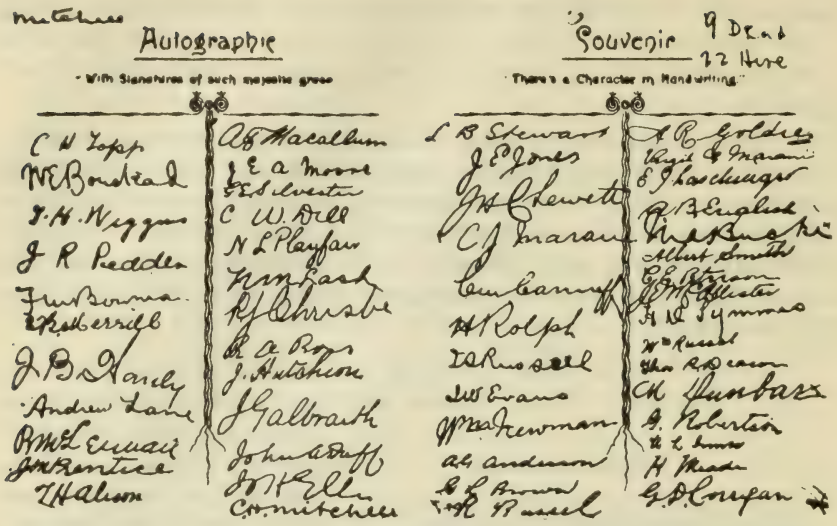
"5 O'Clock, Gentlemen."



Prof. Graham

The first dinner of the Engineering Society was held at the Hub on Jan. 31st, 1890. A grand total of 54 assembled, and among them was Dean Mitchell, who was the freshmen's representative on the executive.

We reproduce an autographed menu used on this occasion. The signatures of most of the undergraduates and some of the graduates will be found on it.



Mr. R. A. Ross, E.E., of Montreal, has written us, in response to our appeal, as follows:

R. A. Ross, '90.

"Yours of January 14th and 24th, with reference to memories of Undergraduate Days, has been causing me a lot of worry. I am sorry to say I have few recollections of those days except those involved in hard work; and, looking back, I cannot help feeling that my year, including myself, was a rather uninspired and uninspiring bunch. We had no time for frivolities like the Arts men; and a more drab existence from the point of view of literature it would be hard to find. My own recollection is of the freedom I used to feel at 8 o'clock in the morning when, waking up, I realized that I only had to spend the rest of the day in listening to lectures, drafting and studying, which, as compared with the previous existence of four years of apprenticeship, a part of which time was spent in wheeling cordwood (extracted from the neighboring snow-bank) for the voracious shop stove, oiling shafting, scrunting castings, carrying off iron on casting days for the moulders, and learning profanity from the boiler makers while holding on, constituted a contrast which was the nearest thing to heaven which I expect to attain to, at least during this mortal life.

"I judge from the remarks of Walter J. Francis and others that I was looked upon as a very serious young man, and more fitted for the undertaking business than anything else; and that seriousness of mine still afflicts me upon occasions yet, so that the lighter and more joyous aspects of student life are absent from my recollection. Also, I was at a dinner last night in Montreal."

We regret that we had no opportunity of interviewing Mr. Ross during dinner, but we feel confident that if he could be approached at exactly the right moment he would favor us with a more optimistic message.

In the fall of 1890 the southern wing of the Red School was completed and occupied. We gather from the address of the president of the Engineering Society (1890-91), the late Mr. J. K. Robinson, that the School was now established on a scale of unprecedented grandure. Mr. Robinson said:

J. K. Robinson, '91.

"We who have worked through the last few terms of this School, in the overcrowded and unventilated condition of its rooms, may and do congratulate one another on the possession of such rooms as we now have, combining as they do good light, good ventilation, good heating, convenience, taste and a spaciousness that will more than accommodate the old students, and the fifty-three new ones that have come among us,"

Further, Mr. Robinson's modesty bade him say:

"Perhaps none that graduate from this School will ever rise to the height of his profession, and surprise the world with his skill. But who knows? It is not impossible. One thing is necessary—thoroughness."

We learn also from this address that Mr. H. E. T. Haultain, "an able and pushing young man," was at this time chief engineer of a tin mine in Bohemia.

The vice-president of the Engineering Society at this time was Mr. T. R. Deacon, now president of the Manitoba Bridge and Iron Works, Limited, and ex-Mayor of Winnipeg. Mr. Deacon writes us as follows:

T. R. Deacon, '91.

"I duly received your letter of the 14th inst., re reminiscences of the Old Red School. I have delayed replying, hoping that I would find myself in a proper frame of mind to write something interesting, but so far the inspiration has not come.

"It will be thirty-one years this Spring since my class left the School, but in many respects it is as fresh as yesterday in my mind and does not seem more than a year or so ago. So far as I know there are only five of our class living, although there may be more, and George E. Silvester is one of them. He was by several years the youngest member of the class. We certainly had some stirring times, but I am not going to deal with that in this letter. I will try and prepare something when I feel in the right spirit.

"I am thankful to say we had no college yell, which I have always regarded as an extremely silly schoolboy proposition, and I am satisfied that older people frequently stay away from entertainments and receptions, etc., given by students, rather than submit to the discordant noise of a lot of kids yelling.

"Inasmuch as all the courses were combined in our day—Sanitary, Civil, Mining Engineering and Surveying, we had to work like "Sam Hill." Our class wrote on 21 subjects the first year, and it was the class of '91 who started a sort of insurrection or protest against this overloading and put in a strong petition backed by other influences to have the course split up and lengthened. In those days most of the classes were older than they are now, the average age probably being 22, although there were some up to 35, and George Silvester was only 16 or 17.

"It was in February, 1890, I think, that the University building was burned down, and I think I was the last student in the building before the fire occurred. It was the evening of the annual Conversat, and I had agreed to remain to look after the things we had on exhibition until some of the others came back. However, the caretaker came along and told me it was not necessary for me to remain as he would shut the iron gates at the front. University College was then lighted by coal oil lamps only, and shortly after I left the building two men carrying a tray of coal oil lamps which they had trimmed in the basement, fell on the main stairs and set the whole place on fire. The nearest hydrant was 1400 feet away, and the water pressure was barely sufficient to throw water into the windows of the first storey, and perhaps 10,000 people stood around, many of them in dress suits and dancing pumps, and helplessly watched the building burn down.

"We had borrowed a great many things to decorate the building, including thousands of dollars worth of special hot-house flowers, and nearly all the large flags that were in Toronto at that time. Of course, these were all burned up, and there was the dickens to pay. As nobody had any money in those days, some of the members of the Finance Committee who had negotiated for the loan of these things were obliged to take to the back townships for a few weeks till the thing blew over. Some hastily changed their names temporarily.

"As some of the University College professors who were there then are still there, and old men, no doubt full of dignity, some of the anecdotes which might truthfully be told about them in their younger days would never do now. For instance, one very solemn gentleman lecturer used not infrequently to arrive at the lecture room showing unmistakable signs of a recent 'jag.'

"Many of the men of the years '92, '93 and '94 will doubtless remember the boxing bouts every Friday evening in the room under the Engineering Supply Room of the old Red School, between the writer and Mark Dunbar (now dead). One weighed 177 pounds, the other 178; each 5' 11½" tall, and each in their 24th or 25th year; both country-bred boys and the best pals in the School. The whole school practically used to assemble, standing on benches around the wall, and watch us go to it until one went

down. There never was any certainty which this would be, as it was only a question of a vulnerable spot left unguarded for a fraction of a second, and one of us would be on the floor. There never was any ill humor, no regrets and no sympathies wasted.

"Most of the students had a wholesome respect for Prof. Galbraith as a disciplinarian, although as a teacher we often thought his processes difficult to follow. Everybody loved dear old Dr. Ellis and had many a hearty laugh over his mathematical embarrassments.

"In those days the classes were small, but at least among the boys from the country there existed a great spirit of camaradrie, and one could borrow anything from a pipeful of tobacco to a dress shirt if anybody in the class had one. I think it is fair to say that in sports and athletic events, and even in the inter-faculty debates, the School held a place in the honor lists out of all proportion to its numbers, and always gave a good account of itself. I believe that it fully maintained this reputation in the Great War. School-men should pull together and not try to destroy one another in the great battle of life afterwards."

The name of Mr. Deacon's eldest son, Lieut. L. J. Deacon, '18, appears in our Roll of Honor.

To Mr. Silvester, '91, we are indebted for the many interesting facts and anecdotes which follow:

G. E. Silvester, '91.

'Ninety-one as a freshman year was composed of around thirty-five, about eleven graduating. At that time there were two sets of examinations, one at Christmas and one in April, each covering the preceding term's work. This practice was abolished about 1889-90.

The President of the University was Sir Daniel Wilson, who was a very dignified old man, very much revered by all, well-liked by the students, for he understood them and allowed many events to pass apparently unnoticed, which with some men would have caused considerable trouble.

At that time many lectures were taken at U. C., and some of the Arts men took Chemistry at the School of Science. Prof. Chapman, who was as well versed in Greek and Latin as in English, was lecturer in Geology and Mineralogy. About Mr. Silvester's last year, lady students began taking lectures at S. P. S., and some were taking from Chapman. Chapman as a rule began his lectures with a few odd stories, which were a bit off-color for a mixed class. However, it always took the ladies five or ten minutes to get around to his lectures from the Arts building, which enabled him to get away with a few before their arrival. Many a time, though, he had to cut them short. Nicknamed "Chappie," Galbraith known as Johnny, Ellis as "Doc," and Baker as "Alfie."

A big evening in the college year was Hallowe'en. This usually took the form of a theatre night, with a monster parade, etc. The old Grand Opera House was always jammed to capacity. The women's residences were serenaded and the Toronto police force, which at that time was very inadequate, was given a rough evening.

The stage stars in Mr. Silvester's day were Rose Coughlan, Sol-Smith Russell, Joe Murphy and Lilly Langtry. The Prince George was the leading hotel and most of the well-known actresses stayed there. Rose was a great favorite with the University boys. After the show, on this special night, they unharnessed the horses from the immense carriage, which was waiting to take her to the hotel, and about a hundred of them dragged it to the Prince George, up the steps into the rotunda, and to the foot of the main stairway and carried her upstairs to her room.

Annual elections of the Literary Society was another big event. There was at that time what was termed a "Brute Force Committee" representing each side—the inside party and the outside party. Naturally, the oldest clothes available were worn on those occasions. Each voter had to run the gauntlet of the "Brute Force Committee," and when the poll was reached, he was as a rule hardly able to vote. Usually some old building on Queen Street West was hired for these rough-houses.

The old traditionary feud between Arts and Meds. existed—no one seemed to know how it began. The three faculties (Arts, Meds., Science) took some lectures together in the circular west room of the main building. The result was that accommodation was very scarce and the first ones in were the winners, it developing into a free-for-all fight when the Meds. (who were perhaps a few minutes behind time) arrived. Arts formed a sort of a "Secret Service," and when Meds. were expected in large numbers an S.O.S. would be sent in to School, who at that time were backing up Arts. The Prof. in charge would look up Sir Daniel, and this worthy old man would appear and attempt to quell the uproar. Mr. Silvester mentioned the fact that School were always the "shock troops" of Arts. After a fight the place would be littered with hats, coats and other torn wearing apparel.

The campus was fenced in in those days, and the University did its own policing. The city police had no jurisdiction over the students when on University property, and this fact was taken advantage of many times, to the odd passing policeman's discomfort. The regulation stunt for quelling the spirit of an unruly freshman was to paint him over with red and black inks and tap him. Transoms were also turned up in a horizontal position and filled with water, a string being attached to them and the door, which resulted in a gallon or so of water pouring down on the first person who entered.

The football star was **Harry Senkler**, and "Matty" Thompson was also well-known—Association, not Rugby football.

"Bob-tailed" cars were being used on College Street in Mr. Silvester's day—very light cars, not unlike the trailers used here now, but pulled by a single horse. There was only a driver, no conductor, to collect the fares, which were passed from one person to another up to the driver. One of the stunts in vogue was to rush down and board a car at the rear and put on the brakes, thus preventing the horse from moving the bus. Then, while the driver was around loosening the brakes, the boys would unharness the horse and chase it away. When this was accomplished, several would go to each end of the car and lift it off the tracks.

The Hon. the Minister of Education (G. W. Ross) said he didn't like the appearance of a high wooden fence which encompassed the old Normal School, so the boys formed up around it on a certain evening, and, at a pre-arranged signal (a bugle call), rushed it in a body and the entire wall collapsed "like the walls of Jericho"—and with a half squad of policemen in the vicinity, looking on aghast.

Principal streets for students' boarding houses were McCaul, Boon, Church and Henry. Average rates were $3.00 per week for board and room. A few of the wealthier students lived in very exclusive residences at about $5.00 per week. The only students' restaurant was on the south side of College, just west of Spadina. Two large stores there were taken over and turned into an eating place, and meal tickets were sold to students. This was run by the proprietor of the present Waverley Hotel.

Concrete in those days was used very little and reinforced concrete practically unknown.

Postscript

Those twin tyrants, Time and Space, bid us interrupt the discussion at this point. We say "interrupt" rather than "terminate," because we hope to meet again when Transactions is published next year, and that on that occasion graduates of the more recent years will join in the discussion. It may be that this beginning will stimulate alumni of all years to commit their impressions and memories of the School to writing before they become too hazy or altogether lost.

Acknowledgments

In addition to those whose names appear above as direct contributors, we wish to thank the following, who have helped us materially in the preparation of these pages: Mr. J. S. Galbraith, Sir Frederick Stupart, Prof. C. H. C. Wright, Prof. H. E. T. Haultain.

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Transactions and Year Book

OF

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EDITORIAL

To its many friends and members, the Engineering Society once more presents its, now annual, publication. It is hoped that the papers which this issue contains will prove useful as well as interesting. As will be seen, the members of the staff have made no small contributions to the fore part of the book. For their very willing and generous contributions we wish to thank them most sincerely. Then, the list of names appearing at the first will ever remind School men of the place they must occupy, if they would be worthy of these who have gone before. But men like these have gone out from School ever since the first man graduated. A desire to preserve as many of the early traditions as possible and to see more School spirit in future classes, has led us to commence what one might call a history. The Assistant Editor spent much time and work on collecting material from a great many sources for this history. He feels that it will help in achieving the desired result and leaves to his successor the task of contributing another chapter on the life of a great institution.

EXECUTIVE:- UNIVERSITY OF TORONTO ENGINEERING SOCIETY.
1921-1922.

RETIRING PRESIDENT'S ADDRESS.

THE time has come when we must hand over our responsibilities to our successors. At such time it is customary to make some review of the activities of the year. The details connected with our various functions are thoroughly covered elsewhere in this publication, so I shall confine myself to a few generalities.

The year that has just closed has not been marked by any outstanding occurrence. Most of our activities have followed the line of well established precedent. The freshman rules as instituted last Fall, were a new departure. The idea was first carried out in our Faculty and in a short time spread to nearly all parts of the University. It has received some severe criticism and also favorable comment. Whether or not they should be put in force next Fall should rest with the incoming second year. Having been through the mill themselves they should know whether the reasons which are given in their favor are all that they are claimed to be.

Our Annual Dinner was held in the Fall and although the attendance was not large, I think it was a success and I hope that those who attended, enjoyed it. It has been seriously proposed that this function should be dropped, and the reason given is that the majority of the members of the Society do not support it. This is true enough, and the atttendance this year was less than that of the year before. It must be remembered, however, that the Dinner is almost as old as the Society itself, and so long as a reasonable number are interested it should be continued.

Following the lead of last year, Spasms was again put on in Massey Hall. It was a success in every phase except the financial. It is very evident that this activity does not receive the support it deserves, and it is open to question whether it should be continued. Perhaps the difficulty could be overcome by making it of more local interest and holding it in Convocation Hall or Hart House Theatre.

Undoubtedly the attendance at both the Dinner and Spasms was affected by the dates on which they were held. They were less than a week apart and came in a period crowded with other University activities. It should be explained that when the time for these two affairs was being considered, at the beginning of the term, it was decided to hold them both in the Fall, if at all possible. The rush of events in the Spring term is phenomenal and we felt that the less left to that period the better. The two dates selected were the best obainable.

Another thing that should be mentioned was our part in the Graduates' Reunion. The officers of the Engineering Alumni

Association rightly look to the Society for considerable help in the details connected with such a reunion. We appointed a committee to co-operate with the various committees of the Reunion and to render assistance wherever possible. This consisted mainly in getting the registration, selling tickets, and making returns for the secretary.

During the Christmas holidays we had the University superintendent put in numerous shelves and a table which were needed for the more efficient working of the office.

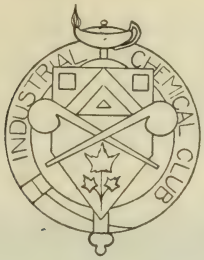
The main feature of the second term was the dance. As the space in Hart House is limited we were unable to accommodate all those who wished to attend. A great deal of time was given by the committee to make this dance a success and I think that it lived up to the reputation that has been established for the Science At-Home.

There have been perhaps fewer general meetings of the Society this year than for some considerable time. This was because of the general policy, adopted early in the first term, that a meeting should be called whenever we were able to secure a speaker with a subject of general interest to all members. This has been no easy task as such people are always extremely busy. In more than one instance, pressure of business forced the withdrawal of a promise made earlier in the season.

As the Supply Department is not being mentioned elsewhere, I would say a few words concerning it. During the past two years a business has been developed in Room 19, the magnitude of which is only realized by those in close touch with it. Because of the revenue obtained from it and the attention that must be given to its management, the Supply Department is the most important of the undertakings of the Society. Since the war the volume of business has steadily increased until now it is as large as can be handled by an undergraduate student. Any further expansions should be considered from that viewpoint. The balance sheet, published elsewhere, shows the result of this year's turnover. The profits are the largest for any year in the history of the department. Such a profit is not necessary and the executive has given considerable thought as to what should be done with it. A reduction in the price of articles could well be made, but it must be remembered in doing this that the general expenses of the Society, due to its many and varied activities, are not covered by the fees, and that a good deal must be made up by the profits of the department.

In closing, I wish to thank all those who have taken an active part in the affairs of the Society. No executive could have been more willing to assume responsibility or done so with better effect. Any success we have had is due mainly to their efforts. I wish the new Committee every success and feel sure that under their direction the prosperity of the Society is assured.

J. A. LANGFORD, President.



INDUSTRIAL CHEMICAL CLUB.

AS a result of the recent sudden increase in registration in Chemical Engineering, that department has become one of the most important ones in the Faculty. There are now over one hundred and fifty members of the Chemical Club, about ten times the number there were ten years ago.

Together with this increased registration there has been a slight tendency toward lack of interest of the members, due chiefly to the unwieldy character of the club. It was the endeavor at the beginning of this term to stimulate the interest taken in the club in three ways. The first was to have at least two of the old-time dinners. The second was that of giving the members of the club an opportunity of delivering addresses, as well as hearing papers furnished by outsiders; and the third, to generalize, if possible, the subjects of discussion at the dinners and smokers.

The year was begun with the following executive: Hon. Pres., Prof. J. W. Bain; Hon. Vice-Pres., Dr. M. C. Boswell; Pres., A. E. H. Fair; Vice-Pres., L. M. Price; Sec.-Treas., H. N. Baker; Curator, V. B. Lillie; Year Reps., 4th Year, H. M. Dignam; 3rd Year, E. H. Carnahan; 2nd Year, S. A. Rowland; 1st Year, H. Trotter.

The first function of the year was a dinner which was held at the Walker House on October 1th. This served as a reception for the freshmen. A record number of ninety-eight members was present.

The speakers of the evening were Messrs. Dignam, Johnson, Breithaupt and Campbell, all of the Fourth Year. Their subjects were: "Acetic Acid From Acetylene," "Paper Manufacture," "Tanning of Sole Leather," and "Efficiency Engineering," respectively. They were extremely interesting and instructive and proved the value of having members themselves provide the entertainment. Mr. Crawford, also a member of the Fourth Year, furnished some very good music in the form of three piano solos.

The Chemical Club dance was held at the Metropolitan Assembly Rooms on November 3rd. This was also well attended and was generally considered to be a success.

A smoker was held at Hart House on November 23rd. The speakers on this occasion were Mr. J. W. Scott, Chief Chemist

INDUSTRIAL CHEMICAL CLUB EXECUTIVE

Standing—

V. B. Lillie (Curator)
H. Trotter (1st Year Rep.)
H. M. Dignam (4th Year Rep.)
E. H. Carnahan (3rd Year Rep.)
S. A. Rowland (2nd Year Rep.)

Sitting—

H. N. Baker (Sec.-Treas.)
Dr. M. C. Boswell (Hon. Vice-Pres.)
A. E. H. Fair (President)
Prof. J. W. Bain (Hon. Pres.)
L. M. Price (Vice-Pres.)

at T. Eaton's, and Mr. H. F. Robertson of the Third Year. Mr. Scott delivered a very interesting address on "Chemistry in the Control of Industry." Mr. Robertson's talk on "Zinc Refining" was also very instructive.

One of the most successful meetings of the club was held in Hart House on December 7th, when Mr. C. J. Brockbank of Buffalo delivered a paper on "Abrasives, Their Manufacture and Use." His paper was also accompanied by a number of lantern slides. We were very fortunate in having Mr. Brockbank in that his paper proved to be one of the best ever delivered before the Club.

At the next Smoker the Club was favored with an address by Prof. Fay of the Department of Economics. A most interesting address was expected, and the Club members were by no means disappointed. The subject of the address was "Economic Conditions in Europe." At the same meeting Mr. H. A. Fair, '21, delivered an interesting paper on dyes.

The last dinner of the year was held at the Walker House. Again the record for attendance was broken. There were one hundred and fourteen members present. Mr. J. A. DeCew was the guest of the evening. He gave some very valuable advice to the members regarding the problems to be met with after graduation. This was followed by talks from Prof. Bain, Prof. Ardagh, and Dr. Boswell. These were all very interesting, especially that by Dr. Boswell, who treated the subject of research from a different point of view from that of Mr. DeCew. A feature of the evening was the presentation to the upstairs Chemicals, '22, with a cup for their success in the Inter-Chemical Hockey. After a vote of thanks to the executive, the meeting was adjourned by Mr. L. M. Price, the president for the coming year.

During the year a course of lectures on first aid in the Chemical Laboratory was delivered to the Club by Dr. R. B. Stewart. These will undoubtedly prove beneficial to the members who were able to be present. An employment bureau was also conducted this year, but its success was somewhat hampered by the present business depression.

The financial condition of the Club is good. Although the Constitution of the Engineering Society provides for financial aid for the affiliated clubs, it has been unnecessary this year for the Chemical Club to ask for such assistance.

In conclusion, I might say that the year was a most successful one for the Club. The members are to be congratulated on their spirit of co-operation. This, together with the unlimited assistance given by the staff, helped greatly in making the year so successful. Therefore I feel confident that, pursuing policies similar to those of the present, and with the support of all the members, that the future of the Club is assured.

A. E. HAROLD FAIR, Chairman.

CIVIL CLUB

EXECUTIVE

Top Row—

K. W. Irwin
(Vice-Pres.)
M. D. Stewart
(4th Year Rep.)
D. Wyatt
(1st Year Rep.)
F. B. Boswell
(Secy.Treas.)

Bottom Row—

W. W. Abernethy
(Varsity Rep.)
A. R. Chadwick
(2nd Year Rep.)
Prof. C. R. Young
(Hon. Pres.)
G. A. McClintock
(President)
A. A. Rose
(3rd Year Rep.)

THE CIVIL CLUB.

THE year is about finished and now for the reckoning. During the past year it has been our purpose to have only speakers whose subjects would be of interest to the club as a whole. In this connection we were able to secure Mr. Hogarth, Chief Engineer of the Ontario Department of Highways, for the first. His lecture on "Highways," which appears elsewhere in this volume, was appreciated by an audience of about 100. In our second lecture the elements were against us, for we were forced to hold it at night and as there was a heavy storm on at the time, lighting and power were both off, with the combined result that there were scarcely more than thirty present. The subject, "Reinforced Concrete as Applied to Engineering and Architectural Problems," which was treated by Mr. Engholm in a different light from the usual, was worth more than the effort of attending. What was lacking in numbers was made up in the interest shown. On March 15th we had our final address by Mr. Fowler, Chief Engineer of the Detroit-Windsor Bridge. His subject was the evolution and architecture of bridges and showed the connecting link between the rock bridge of nature, the fallen tree across the stream, and the modern bridge. This was a banner meeting and as there were over two hundred present, it shows that this included many outsiders.

As regards the social side, we had two Smokers. The first one was free and about 90 were present. At this the Old Gull Lakers played the New Gull Lakers at indoor baseball, but as the Old Boys had not been down in Florida training, they were a little off color, and were badly beaten. The sequel to the ball game was a progressive card game where the members at each table decided what should be played. The meeting was addressed by our Hon. President, Prof. Young, whom we wish to thank for the assistance he has given us at all times. After substantial refreshments and the singing of songs, the party broke up. A bunch of first year Miners, each one in the Romanelli class, vied with one another to produce the best music conducive to good card playing. A second Smoker was given in the second term. It was not so elaborate in detail as the first, nor was there as large an attendance. It hardly need be added that the first one was free, whereas the second one cost twenty-five cents per man, the balance being covered by Club funds.

I wish to express my highest appreciation of the members of the executive, who have given valuable time and energy to make the Civil Club a going concern. I am afraid that members are apt to forget that it is the individual that makes up the Club, and in order that it may appear worth while to a speaker, who has gone to no small amount of trouble and inconvenience in prepar-

MINING AND METALLURGICAL CLUB EXECUTIVE

Top Row—

J. C. Adamson (2nd Year Rep.)
H. G. G. Whitton (1st Year Rep.)

Bottom Row—

F. J. Lyle (Entertainments)
W. S. Maguire (Sec'y-Treas.)
J. Dryborough (President)
A. H. Stratford (Vice-President)

ing his address, there should be a good turn-out at all meetings. So now I would suggest that you should all turn out and give your executive the help that they deserve.

In conclusion, I pass on the sceptre and mantle to Mr. McLelland (the Duke), and ask you to give him all the support you can. As for ourselves, we will just say that if we have not done as well as was expected, we have done our best, while on the other hand, if we have done well, it is no more than we should have done. So, Au Revoir.

G. A. McCLINTOCK, Chairman.

THE MINING AND METALLURGICAL CLUB.

THE Mining and Metallurgical Club has, this year, had the unique experience of functioning during practically the full twelve months. This was owing to the fact that under the auspices of the Club was run the Varsity section of the Student Camp at the Hollinger Mine, which was a signal success. Over sixty School men, from almost all departments, took advantage of the scheme and thoroughly enjoyed their summer under canvas, returning in the Fall with a larger "stake" than the rather scanty employment opportunities available in the Spring gave reason to hope for; with some new experience and with a fund of memories of joys and sorrows, of Hollinger pie, Sunday evening songs and stories, gathering scrap iron, and May snowstorms. There were contingents from Queen's and McGill, and the Student Camp helped to foster and strengthen that friendship between Universities, which only comes of personal contact and undestanding between their members. The Hollinger management took considerable interest in the camp, and talks were given by Mr. A. F. Brigham, General Manager, on "Metal Mining Methods," and by Mr. J. D. McRae on "Hollinger Cost Keeping." In his speech, Mr. Brigham complimented the students on their work and on the manner in which the camp was conducted. A debt of gratitude is owing the Hollinger officials for their kindness and broad-minded attitude in presenting such an opportunity to the undergraduates, and it is hoped that, once begun, the Student Camp will be a feature at the Hollinger in all the summers to come.

Three meetings were held during the Fall Term. The first took the form of a Smoker at Hart House, and was most successful in its object of bringing together the members of the different years. An entertaining programme was rounded off with a short, interesting account of his trip to the Fort Norman oil field by Mr. H. A. Oaks, of the Fourth Year.

The second was taken up with an exhibition of moving pictures on "Rock Drilling," obtained from the United States Bureau of Mines through the good offices of the Sullivan Machinery Co. Then in December, Mr. G. C. Mackenzie, Secretary of the Canadian Institute of Mining and Metallurgy, addressed the Club. He spoke optimistically of the future of the industry in Canada and advised the Seniors, for lack of better employment, to try prospecting for a while.

Following the holidays, at another Smoker in Hart House, Mr. J. P. MacGregor, of the legal firm of MacGregor and MacGregor, spoke on "Company Law," which proved most interesting and called forth much discussion. A point for the consideration of future executives might, with advantage, be mentioned here; that it is not well to procure speakers on technical subjects only, but to have business men, lawyers and others, also address the Club, bringing the layman's point of view and ideas.

A new departure for the Club was a skating party, followed by a short dance. This was a distinct success, largely due to the efforts of Messrs. Heisey, Dumbrille and Brown, who were in charge of the affair.

At the last meeting, a film on "Silver Mining" was shown, followed by a brief instructive lecture on "Heat Treatment of Brass," by Mr. O. W. Ellis of the Department of Metallurgy, and illustrated by lantern slides.

Thanks are due to the speakers who addressed the Club and to members of the Faculty who assisted in procuring these speakers and gave helpful criticism and advice. The executive consisted of A. H. Stratford, Vice Chairman; W. S. Maguire, Sec.-Treas.; J. C. Adamson, Second Year Rep.; H. G. G. Whitton, First Year Rep., and F. J. Lyle. Entertainment, and the success of the year's activities is largely due to their co-operation and labor. Mr. W. S. Maguire is the newly elected Chairman and the affairs of the Mining and Metallurgical Club can rest in no abler hands. May all success attend his efforts in the coming year.

JOHN DRYBROUGH, Chairman.

$SP_AS_S^M$

THE second annual Spasm was held in Massey Hall on the evening of December 1st, 1921. A splendid array of talent and a well filled house went to make this event a huge success and Spasms is assured of a prominent part in the future "School" programme.

The executive committee, in charge of Mr. C. T. Carson, deserve a great deal of praise for the time and work they put in and for the results obtained. Under the practised eye of Mr. Digby Wyatt, '25, stage manager, rapid and smooth staging and shifts were effected without awkward delays, a feature usually noticeable by its absence in amateur productions. A word of appreciation is also due Mr. R. M. Laurie, '24, and Mr. Geo. F. Bryant, '22, for their efficient handling of the innumerable details of the business management and advertising. To the casual observer these details are usually entirely overlooked, but they are, nevertheless, of primary importance to every production.

Limited space will only permit a few honorable mentions of which there should be many. The cup was won by the Class of 1923, Civils and Miners, for their production of "Surveying." This skit was all "local color" and very well done. Several freshmen sustained strained necks in trying to get a second look at the lady. No one happened to be watching any of the staff.

An exceptionally good tumbling act was provided by the School gymnasts. These men looked like professionals and the applause which they received was a good measure of their success. The "heavy" drama was provided by the fourth year Chemicals, and the "heavy" music by McNamara's Band. The Band presented an array of gold braid and multi-colored costumes and played several difficult numbers—these numbers were difficult in that the audience experienced difficulty in recognizing them. The best thing about the Band was the fact that it was disorganized immediately after the performance.

Many good musical numbers were presented, especially by the quartette. These four gentlemen received the same hearty applause as they did last year and delighted the audience with their excellent programme. The School Glee Club presented a rather original number, "The Toronto Dislocation C.," with considerable "local color," which was very favorably commented on by the audience. The setting displayed an originality of choice which perhaps gave this number its greatest charm, apart from the rendering of the songs. What more romantic setting could be conceived than, say, the corner of College and Teraulay, at the witching hour of midnight, on a wet night in late November? The night gang of "dislocators" have just knocked off for supper, and while gathered round the cheery brazier, beguile the weary

SPASMS

COMMITTEE

Back Row—

G. F. Bryant (Publicity)
C. B. McQueen (3rd Year)
D. Wyatt (1st Year and Stage Mgr.)
R. R. Parker (4th Year)
A. M. Johnston (Master Electric'n)

Front Row—

R. M. Laurie (Business Manager)
C. T. Carson (Director and Chairman)
Craig Hamilton (Mus. Director)

moments with songs. A belated wanderer from a "wet" party zigzags upon the scene, and with a stray "cop," decides to throw in his lot with the gang. There were also some good single acts, prominent among them being a dance by a beautiful lady in a fiery costume. The music was provided by Toike-Oikestra, an "All-School" organization, who received the fruits of their labor, not in the form of cabbage and bricks, but in applause and appreciation.

The second Spasm, as well as the first, went to prove that the School of Science provides an education which is not too technical and that the energies of the engineer are not misspent when directed along lines other than engineering.

The committee wish to acknowledge the kindness of the Players' Club in loaning the electrical equipment, and they are also indebted to Mr. A. M. Johnston, master electrician of the Players' Club, for his efficient handling of the lights.

ARCHITECTURE

THE Architectural Club of the Faculty of Applied Science, although the smallest club in the Faculty, has always been a very active organization, and this year of 1921-22 has been no exception to the rule. Owing to the large number of activities and the amount of work entailed in the curriculum, it was decided at the beginning of the term to limit the meetings of the Club to one a month, when some well known architects would be asked to deliver addresses. Under the guidance of the following executive, a very successful year has been passed: Hon. President, Prof. Adrian Berrington; Chairman, J. B. Helme, '22; Vice-Chairman, M. A. Norcross, '22; Treasurer, J. G. Magee, '23; Secretary, P. A. Deacon, '24; Councillors: F. B. Brown, '23; E. Coleman, '24; W. H. Steele, '25.

THE
ARCHITECTURAL
CLUB
EXECUTIVE

Standing—

J. G. Magee (Treas.)
W. H. Steele (1st Year Rep.)
E. M. Coleman (2nd Year Rep.)
F. B. Brown (3nd Year Rep.)

Sitting—

J. B. Helme (Chairman)
Prof. Adrian Berrington (Honorary Chairman)
M. A. Norcross (Vice-Chairman)

Abesent—

P. A. Deacon (Secy.)

It might be said that owing to the greatly increased activity of the University Sketch Club, to which practically the entire department belong, opportunity has been given the students to hear prominent artists speak and demonstrate, which otherwise would have been taken up by the Architectural Club and included in its work.

The opening meeting was held the latter part of October in Hart House and took the form of a luncheon, at which the Club got away to an excellent start. We were favored with the presence of Dean Mitchell and Prof. C. H. C. Wright, besides three members of the O.A.A., Mr. Hynes, Pres. O.A.A., Mr. West and Mr. Wolsey, Secretary O.A.A. Several graduates of the department also were present and, along with the undergarduates, helped to give the necessary impetus to the first meeting.

Mr. Hynes, who has been very much interested in securing adequate protection for the architectural profession, and who has been an ardent backer of the Architects Bill, under discussion in the Ontario Legislature, gave the Club an illuminating address upon this important subject, covering in the course of his speech, the history of the Bill from its first beginnings. Mr. Hynes particularly stressed the point that it was not the duty of the practising architects to educate the younger "rising generation," but this was up to the community as a whole, or the Government, who were the ones who would profit by such education. He stated the architects would do all they could to help, but they must not be relied upon totally.

Mr. Hynes notified the Club that the O.A.A. had decided to give a scholarship of $100.00 to the student taking the highest average in Second Year, and that in the future medals would be presented to any outstanding undergraduates who attained special mention in their work. After a short talk around and discussion upon several questions brought out in the course of the speech, the meeting was adjourned.

The second meeting of the Club was held in Chemistry and Mining Building, when Mr. H. S. Brightley, service engineer of the Indiana Limestone Quarrymen's Association, gave an address on Indiana Limestone, illustrated by moving pictures. This meeting was opened to the Architectural Draughtsmen's Association of the city, and also the Stone Cutters' Association, and was exceptionally well attended. Mr. Brightley explained and illustrated the various stages of the game, from the quarrying to the placing in position of the finished product in buildings.

Owing to the stress of work in the department, no meetings were held in the second term until March, when Mr. John M. Lyle, architect, gave the Club an excellent address on Modern American Architecture, a summary of which is printed in this number of the "Transactions." Mr. Lyle has upon previous occasions honored the Club with lectures which have always

S.P.S.

DEBATING CLUB

EXECUTIVE

Top Row (L. to R.)—

W. A. Becker
(2nd Year Rep.)
S. M. Jones
(1st Year Rep.)
J. A. Paget
(3rd Year Rep.)
W. A. Osbourne
(Sec'y-Treas.)

Bottom Row—

Prof. C. R. Young
(Hon. President)
D. W. Rosebrugh
(President)
G. F. Bryant
(4th Year Rep.)

proven a source of inspiration to the members, and it goes without saying that a "capacity house" was on hand to hear him discuss this very interesting subject.

The senior members of the Club have been fortunate also in having Mr. H. H. Madill take them on several tours of inspection, amongst these being visits to the Gurney Heating Plant in West Toronto and the Macgregor-MacIntyre Steel Company's plant. It is expected that the Annual Undergraduates' Exhibition of Architectural Work will take place shortly in the Sketch Room, Hart House. Last Spring this exhibition was a great success and was well attended by people outside of the University, as well as the undergraduates.

M. A. NORCROSS, Vice-Chairman.

THE DEBATING CLUB.

A DECIDED forward step was made during the year by the institution of a short course of lectures and criticisms on public speaking by Professor Greaves of Victoria. It was felt that it was time that those members of School who were really interested in public speaking should receive some expert criticism of the faults in their manner, style and delivery, and Professor Greaves filled this want. The course was not long enough to correct many faults but it gave to each man a clear idea of what his mistakes were and of how to proceed to correct them.

As Socrates said, "There are three stages of knowledge, first, one is ignorant and knows it not; secondly, one is ignorant but realizes his ignorance, and lastly, one is learned." If the members of the Debating Club cannot claim to have reached the third stage of knowledge they have nevertheless passed the first!

Last Fall, School were unfortunate enough to be defeated in one of the I.C.D.U. debates by Dents, which eliminated us from the Inter College Debates, but our men made a most excellent showing and need no alibis.

This session the First Year were again the victors in the race for the Segsworth Shield for Inter Year Debating. The Third Year were the runners up.

In a meeting held in February, the Engineering Society Cup for the best speaker in School was awarded to "Tim" Weldon of '22. In criticizing the speeches in this contest, Professor Greaves remarked that their quality was a decided improvement upon that exhibited the previous year. If this is true, which we hope it is, the course in public speaking certainly produced some tangible results.

It is too soon yet to make a definite announcement, but there are good reasons for believing that Public Speaking will be upon

S.P.S. - Y.M.C.A.

EXECUTIVE

Top Row—

C. McKeown (Bible Study)
A. W. MacQueen (Social Service and Boys' Work)
A. M. Reid (International Relations)
F. Spence (New Student Service)

Bottom Row—

L. C. Jackson (Sec'y-Treas.)
T. S. Glover (President)
Prof. R. W. Angus (Hon. President)
J. H. McIntosh (Vice-President)
D. Burns (Publicity)

the curriculum for some of the classes next year. If this is put into effect, the importance of the Debating Club, as being the "lab" where theory is put into practice, will undoubtedly be increased.

Congratulations are in order to Mr. A. V. Price of '23 upon his election to the Chairmanship of the Debating Club for next year. Mr. Price has shown a consistent interest in the Club from its inception in 1919. He brings to it a fresh enthusiasm and energy that one who has been too intimately concerned in its councils might not have, and I am sure that under his guidance next session, the Club will have a prosperous year.

D. W. ROSEBRUGH, Chairman.

S.P.S-Y.M.C.A., 1921-22.

UNDER the leadership of the President, Mr. T. S. Glover, the activities of the Y.M.C.A. during the present session have been quite gratifying.

The session opened with the memory of the Elgin House Conference with all its inspirations firmly impressed on the minds of those who were fortunate enough to have attended.

The first important action was to entertain the Freshmen with a social "get-together" evening in Hart House, where the number of their acquaintances increased by bounds.

The Executive met almost weekly and formulated plans and programmes for the year. The Committee on Social Service obtained the time and help of several students to work in the Ward, the University settlement, etc., certain evenings for the uplift of those less privileged and less educated citizens of our city.

The Committee on Study Classes organized several groups of students studying questions of great importance to all. The fact that these groups have increased rather than decreased in attendance during the term indicates the value of these religious discussions to engineers developing a four-fold life.

The past year has been characterized by a realization by the nations of the necessity for international understandings and the need for placing international relationships on better foundations. Dr. John R. Mott, when addressing the University of Toronto in January, stressed the point that such foundations are to be found in Christian principles. That the engineer can play an important part in creating better world conditions will be readily admitted.

A discussion group, under the rather formidable title, "The Committee on International Relationships," with A. M. Reid as Chairman, has been considering the many problems suggested by the above in a series of weekly meetings. Each member has presented a paper on some aspect of the enquiry, and interesting discussions have followed.

FOURTH YEAR SCHOOL EXECUTIVE

Back Row—

L.J. Robinson
(Varsity Rep.)
G. A. McClintock
(Civil Club)
A. E. H. Fair
(Chem. Club)
J. B. Helme
(Arch. Club)
J. Dryborough
(M. & M. Club)
W. C. C. Duncan
(E. & M. Club)

Front Row—

J. G. Spotton
(Secy.-Theas.)
S. L. Coulter
(President)
J. Roy Cockburn
(Hon. Pres.)
B. H. Johnston
H. G. Thompson

Absent—
A. K. Greig
(Athletic Rep.)

While tangible results prove such discussions are difficult to define, the clarifying of ideas and the broadening of outlook resulting therefrom must prove of value. Canada has attained to national status largely through her contact with other nations in the war, so the individual rises to new ideas as he realizes the condition of the "under-privileged" in the world and the need for those who enjoy much to contribute to the welfare of the many.

Mention might be made of the Handbooks which were made possible by the Y.M.C.A. during the summer, which though they almost paid for themselves by their advertising, yet entailed a very great amount of labor in their preparation.

During the year the Y.M.C.A. in S.P.S. was the means by which about two hundred and forty dollars was raised for charity amongst our own students. This was divided among the University Settlement, Star Fresh Air Fund and Sick Children's Hospital.

LLOYD C. JACKSON, Sec.-Treas.

THE graduating class of 2T2, having arrived at the time when it ceases to be an undergraduate body, and its individual members must each follow their own paths in the world, may rest assured that the activities of the past season, in their nature and scope, have been second to none in the history of any class in the past.

The first event of note during the Fall term was the trip to the Chippawa-Queenston power development on October 6th. Through the kindness of the local executive of the E. I. C., who instituted the affair, many of us were able to visit, under ideal conditions, this stupendous creation of Canadian engineers. Although the invitation of the E. I. C. was extended primarily to the senior year, yet there were many of the junior years who availed themselves of this opportunity, and all expressed deep appreciation of the efforts of those who organized the trip.

About this time various members of the class seemed to be developing into book-worms. There was manifested a fondness for the seclusion of the School library, which at any other time might have been looked upon with suspicion or distrust by the normal School man. This activity, coupled with the writing of

copious notes, became more pronounced towards the close of the Fall term, and there were many who carried a harassed look about with them. There is reason to believe that a few unfortunates developed writer's cramp during the vacation!

Early in November the year held a smoker in Hart House, and the evening was enlivened by indoor baseball between Electricals, Mechanicals and Chemicals and the Gull Lake team. Armistice night saw the class gathered at the Metropolitan Assembly Rooms on the occasion of an enjoyable year dance.

The advent of the New Year saw many of the cares of the previous term happily relegated to the past, with the prospect of a busy season, both social and academic. An interesting feature during February in the sporting line was the Inter-departmental Hockey, which helped to promote much friendly rivalry between the various groups. A more informal type of rivalry between the Hydraulic and Thermo Electricals was much in evidence in the study room, and was not confined to any specific date, being merely spasmodic, but none the less effective, in enlivening an otherwise monotonous life.

In the various branches of sport 2T2 has not been behind. Beattie Ramsay has made an enduring name in the annals of senior hockey; Schemnitz has taken his place as a boxer for the Faculty; "Spike" Carruthers as captain of the Track Team; Bishop, Smillie and Glover on the Soccer Team, while the Gym. Team has Williamson, S. Williams, and R. E. Parker. "Tim" Weldon was judged to be the best public speaker in School, and he also took an active interest in the Students' E. I. C.

An account of the year's history would not be complete without some mention being made concerning the active interest taken by Prof. Alcutt, our new member of the Staff, recently arrived from England, in entering so whole-heartedly into many of our activities, and who has so generously given his time and hospitality, in order to make our acquaintance.

We were very fortunate in being given the opportunity to listen to a number of eminent engineers on various phases of hydro-electric engineering, a subject which is of particular value to many of us who will be intimately connected with this branch. Our thanks are due to Prof. Angus, whose untiring zeal and interest in our welfare, both now and in the future, made this series of lectures possible.

The crowning event, of course, was the Graduation Dance, held at Jenkins' Art Galleries on February 23. The patronesses who graciously consented to act were Mrs. C. H. Mitchell, Mrs. C. H. C. Wright, Mrs. J. W. Bain, Mrs. C. R. Young, and Mrs. E. A. Alcutt. The consensus of opinion was that a more enjoyable dance had never been held in the history of the class.

The permanent executive was elected with "Spike" Thompson as President, Beattie Ramsay and D. L. Pratt as Vice-Presidents, and "Tim" Weldon as Secretary-Treasurer.

We have come to the threshold, and looking back on our life in the University with mixed feelings of pleasure and regret, set our faces toward the new life which is opening out before us.

Amen.

STANLEY L. COULTER, President.

THE class of 2T3 has almost completed the third stage of its journey through School. Even though our numbers have decreased from 402 to 286, the spirit of co-operation and energy which has been so typical of 2T3 in all its activities has not decreased in the least with numbers, but, on the contrary, has increased, as a survey of the activities of the past year shows. Individually and collectively the past year has been everything that could be desired. The individual activities of the class have not been confined to the class or school, but are widespread throughout the university.

In Varsity athletics the class of 2T3 takes second place to none. Every first team has one or more 2T3 men on it; the only team on which the class is not represented is the Women's Hockey Team, and that isn't their fault. Some of the men on those teams are:

Rugby—Duncan (captain during the past season), Rolph and Carew.

Soccer—M. O. Evans and N. F. Johnston.

Hockey—Evans.

Gym. Team—Wolsey.

Water Polo—Bell, Fitzgerald, Wells, Conklin and Harston.

Swimming—Fitzgerald, Harston and Wells.

Basketball—Duffell.

Track—Bell and Langford.

Rowing—Bell.

Boxing—Goldie.

Thirteen T's have been won in the past three years by members of the class, a record any year can well be proud of. Not only in Intercollegiate athletics are 2T3 men active. Most of the School and Senior School Interfaculty teams have a remarkable number of our class on them. Thirty-six T's are the prize for this.

Not only in athletics has the class been active. This year

MECHANICAL
AND
ELECTRICAL
CLUB

Back Row—

Prof. E. A. Allcutt
(Hon. President)
W. R. Carruthers
(1st Year)
Prof. H. W. Price
(Hon. Pres.)
H. J. Pugsley
(2nd Year)

Front Row—

W. L. Yack
(4th Year)
W. C. C. Duncan
(Chairman)
J. G. Inglis
(3rd Year)

one of our classmates, Tony Reid, started a Student Branch of the E.I.C. in the School; since then, McGill and Queen's have had branches started there too. Several papers were read before meetings of the branch by members of the class. Tony deserves great credit for his work in this connection. The class was represented on Hart House committees. Terry Carson was chairman of the Spasms Committee. The best skit, which won the trophy, was put on by members of our class. The University of Toronto Glee Club had its quota. Herb McManus was Business Editor of the Varsity. Many took a great interest in the Toike Oikestra. These are just a few of the individual activities.

The 2T3 Year Dances have always been looked for with eager anticipation. This year was no exception and the affair, which was held at Columbus Hall, lived up to expectations. Four hundred of the members of the class, and their friends, joined together in making the dance the best yet. Everyone enjoyed it to the very last. The Tea Dance must not be forgotten although it has not taken place yet. It promises to be one of the most delightful social functions of the year, although it is the first of its kind that the class have held; but 2T3 are behind it, therefore it needs will be a success.

In closing, I should like to take this opportunity of thanking the executive for their excellent work and the year as a whole for their co-operation and support.. As a result of the recent elections, Bob Morrison is our new President, and we wish him the very best.

JOHN FARLEY, President.

LAST September, when the class executive for the current year took over from its capable predecessor, the first thing to do was to examine the membership. The class sustained the inevitable losses due to the "Spring Handicaps" and a few members dropped out for other reasons. But, regrettable as these losses were, they were undoubtedly compensated for by a score or so who were promoted from 2T3, and by eight students from other colleges.

The evident "greenness" of the freshmen could not long be ignored. So, early in the term, their many admirers in the second year gave them a reception in the Old Gym., the warmth of which was surpassed only by the variety of methods employed. This contact with real School men was of great benefit to the new arrivals and the latter were loud in their expressions of appreciation, many commenting favorably on the impartiality of the

TOIKE - OIKESTRA

Top Row (L. to R.)

W. S. Yates
P. C. Davidson
G. H. Voaden
H. F. Robertson
D. D. Flett
W. G. W. McKenna
C. L. Spence

Bottom Row—

K. G. B. Ketchum
P. S. Edwards
A. Kingsmill
C. T. Carson
K. Griffin
S. R. Muirhead
S. R. Lavender

Absent—

C. Hamilton (Conductor)
J. E. Buchan (Pianist)
G. S. Moybury
T. M. West

treatment they received. The whole ceremony was ably organized and conducted under the leadership of Tom Kingston.

Having seen something of the Frosh, the next step was to see something of each other. With this end in view, a smoker and a class dance were held in November. The smoker took place in Hart House, and was one of those parties at which everybody sings whether he can or not, and everybody enjoys himself whether he wants to or not. This enthusiastic gathering of the clans was engineered by a committee headed by "Roger" Crossgrove. The arrangements for the dance were "convened" by "Chuck" Sharpe, and he and his assistants, ably supported by a large number of classmates, showed their guests that 2T4 *can* stage a dance.

Before the first term ended, the worthy freshmen insisted on returning the sophs' hospitality at a smoker down town. They "did us proud" at the Prince George, and the united efforts of the two years produced stresses in the rafters of that hostelry that will not be equalled for many years to come.

The class dance in November was a rare treat no doubt, but even that would not satisfy some "shakers of a wicked leg." So the class returned in force to Columbus Hall one Saturday afternoon in February, and had such a good time that a regular epidemic of tea-dances may be expected from 2T4 next year.

In addition to Interfaculty and Intercollegiate sports, in which the year is as well represented as any, two Interdepartmental schedules were played within the year. Mechanicals won the Water Polo championship of 2T4 and Electricals the Hockey. Handsome trophies had been provided, but after they were used on election night they could not be located. However, the members of the winning teams are being presented with pennants by which to remember their victory.

In a Faculty like Applied Science, there is some danger of groups becoming isolated from the rest of the year. It should be the task of every class executive to overcome this danger as far as possible. Considerable success has attended the efforts of the two year committees 2T4 has had so far. May the other two be even more successful. With Bill Reid as President next year, nothing should be impossible.

Mention should be made in closing of the latest arrival in the class, Ralph Lockwood Robinson, born a few weeks ago, who received a christening mug from his 195 godfathers in 2T4.

J. M. DYMOND, President.

EVERY year a collection of young men gather in the first year draughting room to "swap" acquaintances. Many have friends among the crowd; many, probably the majority, are total strangers. An observer might hear such queries as "Where are you from" "Do you know ——?" and the like, and he would probably conclude that some means of forming new acquaintances should be instigated.

This happy thought was borne forcibly to the minds of several seniors and juniors, with the result that the new aspirant "Ngynrs" were provided with an unfailing means of identification.

A tie is a more or less conspicuous portion of a young man's apparel, varying directly in conspicuousness as the hue. As Mr. Webster no doubt remarks, the word "green" is applied to a novice, an apprentice, or one seeking the first stage of mental enlightenment. Why should not some insignia of that color adorn a seeker of knowledge to identify him from other ordinary mortals?

For a month we suffered publicity and then the sophomores treated the assembled year to a whacking good time, also relieving us of our now severely stretched neckwear.

We had now blossomed forth as Student Engineers and were henceforth "School men." Was not the final reward worth the indignities suffered by our respective persons? It was!

Our year was now under way. After untiring work on the part of the elected executive, our late tormentors received good in return for evil, and were entertained royally at the Prince George by the Freshmen. That night was fittingly described in the "Varsity," and everyone had a thoroughly good time.

Many of our men were members of the School Rugby teams and here they acquitted themselves admirably. In the Debating Club our members were successful in annexing the Segsworth Shield, thus proving themselves capable of taking their place amongst the best. Early in the following Spring the year held its class dance at U.T.S. The event was greatly enjoyed and fully repaid the executive for their time and trouble.

The year is broadening out in experience and before the close of the 1922 term will be united into a smooth, easily working organization. The class contains some very young members in comparison with other years, but they are fully imbued with "School spirit" and will, I am sure, live up to the high traditions set by School men in the past.

HAROLD L. NORMAN, President.

THE GULL LAKE SURVEY CAMP.*

By J. W. Melson, Lecturer in Surveying.

"PADDLES up, Spike," came a voice from the stern of the Peterboro canoe as she came around the bend at the head of a swift bit of river, "these balsams look to me like the makings of a pretty good bed."

Measurement of stream flow with current meter.

"Righto, your honour. I'm agreeable. By this time to-morrow we ought to make Varsity Bay if this map and my judgment are at all reliable."

Conversation similar to the above is to be heard on about the nineteenth or twenty-ninth of August along the canoe route from Bobcaygeon to Haliburton at a point about one day's paddle from the Gull Lake Surveying Camp.

In this camp our students in Civil and Mining Engineering get their Third Year field work in Surveying for six weeks and a month respectively. The Haliburton division of the Grand Trunk Railway from Lindsay north is the recognized route into this country but the old canoe route is still the choice of some students who prefer that means of travel and also wish to have their canoes by them during the stay in camp.

Students in Civil Engineering are requested to report at Gelert on the Railway on August 20, whence to travel by stage eight miles to Minden on the Gull River and then, in a scow towed by a steamboat, five miles down the river and around the shore of Gull Lake to the University Camp. Students in Mining Engineering are expected to do likewise on September first; all to remain in camp till the Fall term opens in Toronto.

As recently as 1919 all the Surveying Field Work was done —i.e., what could be done was attempted—in the University Grounds at Toronto, but as this had always seemed but a weak imitation of what practical Surveying should be, it was resolved

*Reprinted by kind permission from the University Monthly.

by the staff in Surveying that a camp should be located somewhere in the country far from the inconveniences of the crowded city where the man behind the telescope could be given a chance to open out and use the instrument as it was intended it should be used and not tie it down to toy railway lines and imaginary power sites. But the trouble was not all with the riverless bridge-building, the quantity of the work was affected as much as the quality. Could a student be expected to produce results with eighty per cent. of his time-table taken up with other studies and his chances for slipping down town of an afternoon so easy? And, moreover, with co-education in full swing, why is a telescope anyway, and is it reasonable that a steel tape should always lie flat on the side-walk?

The outcome of all this was a scouring of the north country by Professor L. B. Stewart and Mr. Banting in search of a territory where many varieties of survey work could best be conducted. An eighty-acre lot was purchased on the north shore of Gull Lake in Haliburton between the points where the Gull River glides in and where Rackety Creek lowers its foaming waters, a hundred feet in 400 yards, from the Bob Lakes.

As well as the actual University property, students have the run of the roads and lake shores in the neighbourhood. This expanded area gives opportunities for long-distance work, such as Secondary Triangulation, Camera Survey, Differential Levelling, Stadia Traverses, Shore Line Surveys and Highway Improvement Surveys.

There is one stretch of beach quite close to the University which is admirably suited to Base Line Measurement. Hairs are split about as fine on this linear measurement as they are on the angular measurement of the triangles.

Hydrographic work is done in the University Bay, such as water lot surveys and spot soundings, and up Gull River, where

Main Building and Staff Offices.

the amount of flow is measured. The illustration shows a party in the act. Hanging from a cable they have sounded the river from bank to bank and are now going over the course again with the current meter measuring the speed of the stream as it varies from one side to the other. It is proposed to use the basin of Rackety Creek as the site of a hydro-electric power development scheme next year, its condition being ideal for such work.

Within the area of the University Lot, such standard surveys as, Stadia Topographical, Micrometer, Boundary Line Traverse, Mine Surveys, Railway Cross Sections, and Spiral Curves, etc., are run. The Railways are now full sized and the vertical lines in the Mine Survey run down the cliffs at the foot of Varsity hill which rises 150 feet above the Lake instead of down between the steps in the Old Red School. These cliffs hang over about seven feet. Toward the end of the season the astronomic work is done. "Altair" and "Alpha Lyrae" make ideal time stars and of course Polaris is unfailing for Azimuth work.

To encourage the beginners in Astronomical work a "Latitude with Sextant" observation is taken from the sand close to the Lake, using the real horizon of the Lake as a reference line and sighting the sun. This is the time-honoured nautical observation and serves to show students that Astronomy may not be so difficult after all.

Serious work is done at Gull Lake from nine to five, including drafting of work that is done simultaneously in the field. Of the four University buildings, the main building is the one shown in the illustration which contains one large and four small rooms, used for lecturing and drafting principally, but also used as studies in the evenings and as storage for the instrumental equipment.

But all is not taken seriously at camp, and the student is not overburdened with toil. After 5 o'clock he indulges himself in all the varieties of amusement that offer. Generally it is a swim and dive first. At the diving ladder on the point, all heights from two feet to eighteen can be taken into fifteen feet of water and within a few feet of the shore at that. Eating is not one of the least interesting pastimes to which the boys are given. The one and only call is invariably followed by a stampede. After supper the evening may be spent at baseball on the clearing in the middle of the lot, for this place is an abandoned farm, or in punt-racing, providing the season is early and the days long. Should the evenings be dark, then roll a few

logs together and tune the cigar-box banjo. This said banjo is not such a musical horror as might be supposed, especially when the full chorus tries to drown it out. In fact, on a still evening the effect of the bon-fire and the chorus is very pleasing.

When the above pleasures fail to draw the man, then he may be certain to find just the proper weight of fiction or animal story in the Gull Lake Branch of the University Library consisting of some hundred books. What a homelike place is that bunk-house with its eighty beds! Here are boys playing cards, there is a group known as the "Calculi" grinding for a supplemental, and everywhere else are the individuals each in his own setting of undress comfort.

The drinking water is taken from a spring on the grounds. A pumping station supplies the buildings with water.

Besides the main building, bunk house, and dining-room-kitchen, there is the staff cottage, containing offices for the faculty which consists of Professors Treadgold and Crerar, and Messrs. Banting and Melson. Underneath the staff building is the photographic dark room where the Camera Survey pictures are finished and where students are given every encouragement in amateur work, being supplied with the necessary equipment and having at their disposal a film-tank developer.

"Well, Spike, Old Horse, we did that lake in about half the time it took us coming up."

"Quite right, Mel. I'm a new woman since I came to this place."

"How do you account for it?"

"I'll say it's partly the piny breezes, partly the thousand feet up, and partly the grub. But oh, that steady outdoor exercise, and that good fellowship around the camp fire!"

So ends the Gull Lake season and at the same time so begins the life-long season of friendship.

The First and Second Year's field work in Queen's Park serves effectively to prepare a student for genuine surveying in the Third Year, and this Third Year work gives him confidence to undertake a profession that requires a sound knowledge of Surveying. Those with special skill and tastes may perhaps devote their time to the subject, and take the Astronomy and Geodesy option in the Fourth Year.

THE ENGINEERING INSTITUTE OF CANADA.

Student Activities.

By A. W. McQueen.

IN last year's issue of "Transactions," no mention was made of the activities of the student members of the E. I. C. at School. This year it was felt that no book, which included in its subject matter brief accounts of what has taken place among the students at School, would be complete without some reference to the activities of the E. I. C. members.

Early in the session of 1920-21 an enthusiastic committee of students was formed under the chairmanship of A. M. Reid, to boost the E. I. C. at School. Naturally the first task of the committee was to get members. There was already a small nucleus of members at School and before the end of the term this nucleus had increased by over one hundred new members.

The officers of the Toronto Branch were very keen to help and, acting on suggestion from the School committee, obtained permission for parties of students to visit ten of the more interesting plants and engineering enterprises in the city. Several hundred of the students took advantage of this arrangement during the year.

In February the Annual Professional Meeting of the Institute was held in Toronto and a Service Committee of students from School did very fine work by helping with the details of the convention.

During the present session of 1921-22 the members of the Student Committee, E. I. C., found themselves very busy with many things and thought that their best policy would be to consolidate the ground they had won. To this end a Students' Night was organized and held in Hart House, late in November. The speakers were students who gave short talks on engineering subjects in a way which reflected great credit not only on themselves, but also on the Faculty to which they belong. So successful was the meeting that another and similar one was held early in February. It is believed that these meetings are unique in character so far as Canada is concerned.

To those who are not familiar with the E. I. C., it may be said that the Institute is the professional society in this country and embraces in its membership all classes of engineers. Practically all the prominent engineers in Canada are members and its membership has increased nearly sixty per cent. in the last five years. The Institute aims, among other things, to help its members in every possible way, and to enhance the usefulness of the profession to the public.

SCHOOL
DINNER
COMMITTEE

Top Row (L. to R.)—

W. D. Jewett
W. R. Richardson
C. H. Van Horne
S. M. Jones
J. M. Drymond
F. B. Coles

Bottom Row—

E. W. Cockerline
J. A. Langford
S. L. Coulter
C. A. Norris
W. E. Carswell

THE SCHOOL DINNER.

THAT ancient and honorable institution which is the safety valve for excess School spirit, was held on Tuesday, December 6th, 1921, at Bingham's Down Town. This Thirty-Second Annual Banquet had a unique feature in that it was held on the night of the Dominion General Elections, and announcements of election results from time to time during the evening added "pep" to a very entertaining program of toasts and music.

Over three hundred sat down to a "capacity" meal during which the "Toike Oikestra" co-operated with the chef in a combined assault on ear and palate, producing that happy state of mind which is the secret of the Dinner's popularity.

The usual toasts were given, the speakers being introduced by Jack Langford and received with wild enthusiasm. Beattie Ramsay, in his own words, "faced off the puck" in splendid style by proposing "The University." Principal Maurice Hutton responded as only Principal Hutton could. Being a Classics scholar, he naturally delved far into the misty past and, having related Socrates' experiences with engineers, he passed into the realm of mythology by referring to the time when "The Varsity" was read for its literature. Dean Mitchell and Prof. C. H. C. Wright, in order, no doubt, to persuade themselves that they were not as young as they felt, both recalled their freshman days. The Dean was present in his freshman year at the first School Dinner and in Prof. Wright's freshman year an event of scarcely less importance occurred in that Eastern and Western Canada were linked by rail.

Other speakers were E. L. Cousins, '06, of the Harbor Commission, W. A. Osbourne, '24, "Spike" Thompson, '22, W. E. Bennett, '23, and representatives of McGill, Queen's and R. M. C. Entertainment was provided by the Science Quartette, "Long Willie's Jazz Hounds," and Prof. E. A. Allcut. The latter was tried on the charge of being three weeks late at the beginning of the term, and sentenced to sing for it. The sentence was carried out on the spot, much to the satisfaction and delight of those present.

Stan. Coulter and his committee are to be congratulated on a Banquet at which that intangible but essential spirit of good fellowship was in evident abundance.

SCHOOL DANCE COMMITTEE

Top Row (L. to R.)—

G. Lindsay
W. A. Osbourne
C. B. MacQueen

Bottom Row—

J. A. Langford
J. Dryborough (Chairman)
K. L. Carruthers

Absent—

H. H. Lawson
D. A. S. Lee

THE ENGINEERING SOCIETY ANNUAL AT HOME.

THE Annual Science "At-Home," School's biggest social event of the Spring Term, was held at Hart House on Feb. 3rd, 1922. This event, always successful, was even more so on this occasion, and deservedly so, after the efforts which had been put forth on its behalf by the committee in charge, aided by a number of willing helpers. The following ladies kindly consented to act as patronesses: Mrs. C. H. Mitchell, Mrs. C. H. C. Wright, Mrs. H. E. T. Haultain, Mrs. P. Gillespie, Mrs. J. W. Bain, Mrs. C. R. Young, Mrs. T. R. Loudon.

One of the most commendable features of the dance was the decorations, and those who are acquainted with Hart House Gymnasium will concede that this feature requires much consideration. The "false ceiling" effect, obtained by the use of paper streamers and the abundant and tasteful display of flags, told of infinite painstaking on the part of those responsible. To this was added a lighting effect which also bespoke of School brains, and which gave to the scene a glow of happiness which contributed much to the success of the evening.

The favorite sitting-out rendezvous was the gallery of the beautiful Hart House pool. A novel feature was here introduced by providing amusement in the form of an exhibition of high and fancy diving.

Supper was all that could be desired and the arrangement of the dance programme so as to allow three dances between supper sittings, proved to be a great factor in avoiding delay.

As regards the programme, nothing more need be said than that novelty dances, including "Snowball" and "Balloon" dances were in evidence and "wandering moonlight beams" supplied with wonderful effect by the aid of a spherical mirror, which excited much comment. J. Wilson Jardine supplied the music and co-operated with the committee in running the dances on schedule time.

The Dance Committee and those who helped them are to be congratulated on having added another to the long list of School functions, and one which was of outstanding merit and worthy of the best traditions of School.

S.P.S. ATHLETIC ASSOCIATION

R. C. Relyea (Sec'y-Treas), F. S. Seabourne (3rd Year Rep.), W. B. Ramsay (President), D. L. Polack (1st Year Rep.), K. V. Heyland (2nd Year Rep.), G. W. Smart (Vice-Pres.)

SCHOOL ATHLETICS, 1921-22.

Executive for 1921-22.

President .....W. B. Ramsay
Vice-President .....M. P. MacLeod
Secretary-Treasurer .....R. Relyea
4th Year Rep. .....K. Greig
3rd Year Rep. .....F. S. Seaborne
2nd Year Rep. .....K. V. Heyland
1st Year Rep. .....D. L. Polack

SCHOOL has completed another one of its successful years in the sporting activities of the University. Every Varsity team has had a large percentage of School men on it. This is the spirit that School has always stood for and is one that should ever be foremost in the minds of men from the little Red School House. Varsity First, Faculty Second, has been, and should ever be, our motto.

Despite the fact that so many of our men have been playing on University teams, School has been very successful in the interfaculty contest. Five championship cups will rest for another year with us, namely, Track, both outdoor and indoor; Soccer, Swimming and Water Polo.

Our Senior School Hockey team won their group in the Jennings Cup series, and went down to defeat to the Victoria team, the champions, after a hard battle. In Rugby, neither team were able to win out in their groups, but both teams played good Rugby. Our Indoor Baseball team are still in the running for the championship, and look like winners. The Junior School Basketball team have won their group and look like real contenders for the Sifton Cup.

The Athletic Executive have been very much helped this year in carrying out their work by the bringing into effect last year of a compulsory athletic fee of $1.00 per annum. F. R. McDonald and his executive of last year are to be complimented very highly on putting this through, as it has done away with many former difficulties.

School this year boasts of five captains of University teams—K. L. Carruthers of the Track; R. H. Keefler of the Swimming; G. G. Duncan of the Rugby; R. J. Williamson of the Gym. team, and G. L. McGee, of th eRowing Crews.

In closing, on behalf of the executive for 1921-22, I wish to thank you all for your support this year and to wish you all much success for the coming and future years.

W. BEATTIE RAMSAY,
President Athletic Association.

Rugby.

By Gordon Duncan, Captain Varsity I.

In the words of "Transactions, 1921," we have: "The success of last year's Varsity team was largely due to the capable coaching of Laddie Cassells." This year we need only substitute the name of "Jack" Maynard, and we are correct to the seventh decimal place. "Jack" certainly gave all he had in the interests of the team.

Though not as successful as last year, the Senior team came through with the Intercollegiate championship, partly through the brilliant feat of holding McGill to a 4-4 tie game at Montreal, and partly through the generosity of Queen's in thrashing McGill in Kingston. Queen's were the surprise of the league, winning both home games and losing here a hard-fought game 13-12.

After another thrilling battle Varsity was forced to hand over to the Argonauts the Earl Grey Cup, emblematic of the Canadian Senior Rugby Championship. Many of the seventeen thousand who saw the game have stated that the score, 20-12, does not indicate the relative strength of the two teams.

The prospects for the coming season are very bright. The choice of Harry Hobbs for captain is a very popular one throughout the University. The team loses by graduation two brilliant outside wings in Frank Fisher and Perlman, as well as the services of Keith Carruthers, who played a great game against Argonauts.

Varsity seconds, under the leadership of Doug. Catto, also of School, deserve our sincere congratulations on retaining the Intermediate Intercollegiate Championship. Too much credit cannot be given to the second team for their unselfish work during the Rugby season. They take the bumps night after night in practice games with the Seniors, and incidentally put up a great battle, quite unnoticed by the University at large. It is quite probable that the second team will be entered in the Senior O. R. F. U. series in future. This should do a great deal towards encouraging interfaculty players to turn out for this team.

In the Mulock Cup series, both Senior and Junior "School" teams lost out. True, the group winners from Senior School's part of the league won the cup, but even so, School seems to lack something. This cannot be due to the lack of good material at S. P. S., of which there is an abundance; but rather to lack of regular practices. In order to win the Mulock Cup it is necessary for all the Rugby players in "School" to turn out regularly and fight for positions on their teams. How about Senior and Junior School for the Mulock Cup finals next year?

HOCKEY.

By W. Beattie Ramsay, ex-Captain Varsity I.

IN some ways the past season, as far as the senior University team is concerned, has been disappointing. After the success of last year, when our team went through to the Dominion Championship, winning the Allan Cup, everyone looked for another big year. The team, with the exception of Sullivan and Olson, was intact from the previous year.

The season started with the S.P.A. series, and the Varsity team came through it, defeating Granites, Kitchener, and Argos. The successful tour of the States followed this, and the team came home winning seven straight victories from the best that Uncle Sam could produce.

The O.H.A. senior series then opened, and the Argos were defeated by an overwhelming score. Next came the Granites, and that long-to-be-remembered 30-minute-overtime game, from which the Granites emerged victorious. It was at this point that the Varsity "slump" started, and three successive games were lost to Aura Lee, Kitchener, and a second to Granites. Many articles have been written on the slump, but I, personally, think the break came in that first Granite game. Carson, our star centre man, played 85 of the 90 minutes that night, and never recovered from the gruelling he received for three weeks, on top of which he received severe injuries in both the Queen's games. Stan. Brown, the lightning defence man, received injuries in the S.P.A. series from which he did not recover fully for a month. This took away a great deal from the effectiveness of our attack.

In the Intercollegiate series every game was won by Varsity. School had two representatives, Ramsay and Evans, on the senior team.

The Intermediates were defeated in their group in the O.H.A. and also in the Intercollegiate series. School were not represented on this team.

The Juniors were also defeated in their group in the O.H.A. and also in the Junior Intercollegiate. Dickenson was the only representative from School on this team.

In the Jennings Cup series Senior School won their group but later went down to defeat to the championship Victoria College team, after a hard struggle.

S.P.S.

SACCER

TEAM

(Interfaculty
Champions)

Top Row—

J. Maclellan
J. H. Browne
L. D. Campbell
R. H. Cooke

Middle Row—

M. Meikle
E. S. Lecroyd
Prof. C.H.C. Wright
(Hon. Pres.)
C. P. Bruels
G. D. Scott

Bottom Row—

S. S. Smillie (Mgr.)
W. R. Dunbar
H. E. Wingfield
C. H. Lucas (Capt.)
W. V. Bishop

Soccer.

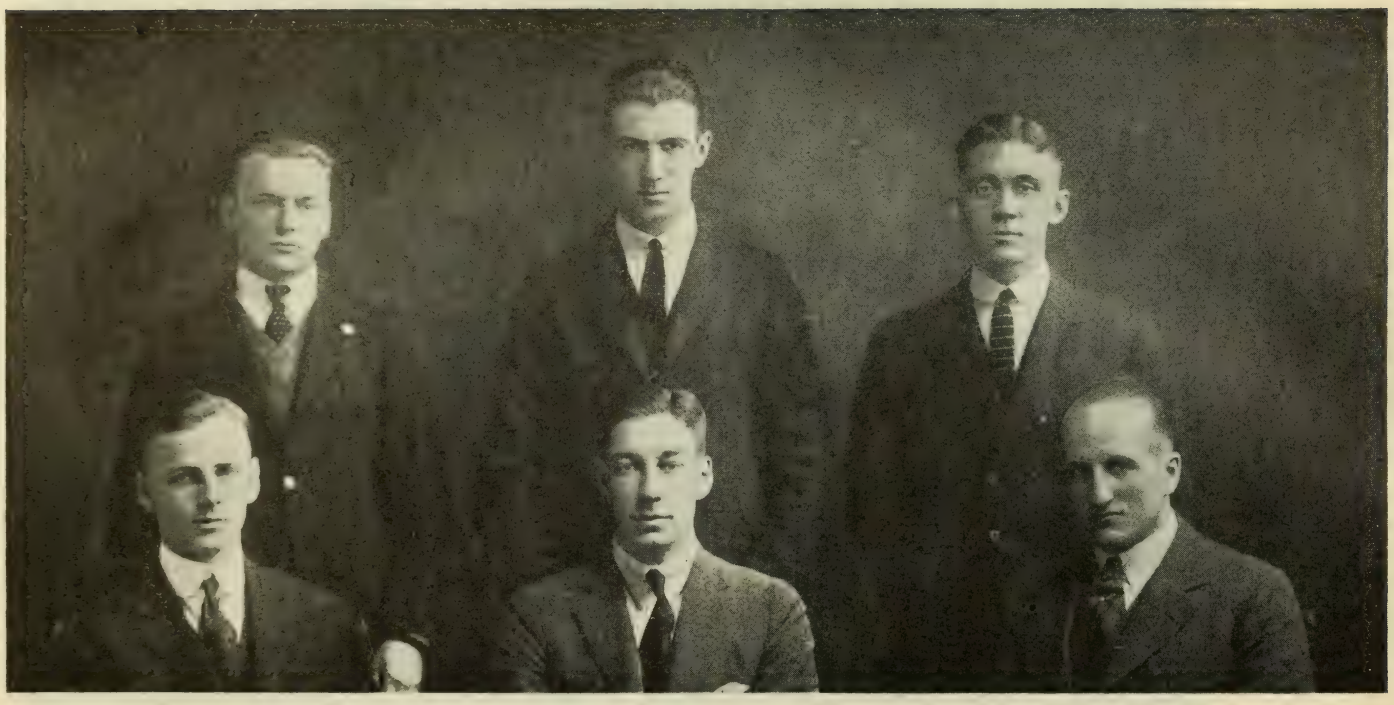
By S. W. Archibald, Pres. Association Football Club.

At the commencement of the Soccer season, 1921, Varsity Firsts, Seconds and School interfaculty champions had exactly the same teams available as last year. Several men who had played well in the interfaculty and seconds were out for a place on the Firsts and Dents, Victoria, and O. A. C. were each determined to relieve School of the Faculty Cup.

There was considerably more interest shown than in previous years, and the twelve Interfaculty teams entered were divided into three groups. O. A. C., who entered the Interfaculty as well as the Intermediate series, was given a bye until the semi-finals, when they met the winners of Group three. The semi-finals brought School vs. Dents, and both teams entered the series confident of winning, and feeling ran high after the first game resulted in a no-score draw. The second game was won by School 2-1, but was protested, Dents claiming a goal when the ball was deflected into School's goal off a spectator. The referee declared no goal on the field. The protest was allowed by a committee of the executive, and ordered re-played. School played under protest, and on a very slippery field lost 1-0. School's protest was considered by the Athletic directorate, which threw out the last game on the ground that regulations had not been followed in dealing with the first protest, and further upheld the referee's decision, giving School the right to meet O. A. C., who had disposed of Victoria in the finals. By beating O. A. C. here and holding them to a draw at Guelph, School kept the Faculty Cup for another year.

During the season two School men, Glover, centre half, and Bishop, centre forward, went to the first team and made good. School had five men on the First team, which won the Intercollegiate from Queen's quite easily, and although they didn't qualify in time to get on the T. and D. schedule, played an exhibition game with the British Imperials and won a closely-contested, well-played match. This was the first break of University soccer into city football, and next year should see Varsity well up in the T. and D. Efforts are also being made to strengthen the Intercollegiate series. The second team, composed largely of School's Interfaculty champions, won the series from McMaster and O. A. C.

Next year most of the School players will be back, and with "Red" Wingfield, president of the University Soccer Club, a most successful season may be looked forward to.



S.P.S. TRACK CHAMPIONS

Standing—E. F. Connolly, W. L. Thompson, G. Rumble.

Sitting—A. A. Bell (Captain), K. L. Carruthers (Individual Champion), G. B. Langford.

Track.

By Keith L. Carruthers, Varsity Captain.

In introducing the subject of track, need we mention that School retains the Cricket Club Cup for the third successive year, and are already well on the road to their third indoor championship. That is an enviable record, and it is up to School men in the future to keep up the good work, even should it seem to become monotonous.

In the interfaculty meet in the fall we were provided with little opposition. Our three giants, Bell, Langford and Carruthers, won all the points in the three weight events; Rumble came through with a win in the 220 yards; Thompson the same in the mile; Carruthers the hurdles, and Turner did well in the jumps. Carruthers, the Varsity captain, broke two records for School in the discus and the hurdles.

The indoor meet, though just fairly under way, shows School predominant in the field events and sprints, and that should in itself be enough to win the championship. We have so far won the 50, 220, 440 and half-mile, as well as the high jump and the shot. We should win four of the seven events left, and there you are. Evans and Boake are new discoveries.

The Intercollegiate meet, however, resulted in a third straight win for McGill. Unless we develop a sprinter or so who can do 10 1-5 or better we will never win. That sounds pessimistic, but McGill will win first and second in all the sprints until such is the case. Surely out of a large University like this we can find one man who can sprint a little bit. Such is not the case now.

Varsity won the three miles, with McAuliffe breaking the record; the high jump, the broad jump, the pole vault, hurdles, and discus, Carruthers breaking a record in the latter. The hurdles were run in the darkness, and this undoubtedly prevented a new record being hung up. Look out for Lanky Rowell in it next year, however.

Harrier.

By Keith L. Carruthers.

Ontario Agricultural College came down with a well-balanced team and took from Meds the Harrier championship. None of their men were stars, however, so on their departure for the Intercollegiate race at Kingston we find the Varsity team composed of McAuliffe, Leigh, Bell, Stevenson and Craigie, none of whom had the fortune of coming from S. P. S.

At Kingston Varsity made almost a joke of the race, our men running 1, 2, 3 and 4, well ahead of all other competitors. In fact, number three and four worked it so that they crossed the line together, thus qualifying for their "T." This is a championship which we should retain for some time, as apparently no one can approach us at distances over a mile. Here's hoping!

S.P.S. WATER POLO TEAM—Eckhardt Cup Champions

Standing—C. A. Booth, B. C. Watson, A. A. Bell, E. E. Schinbein, A. N. Conklin.
Sitting—A. M. Fitzgerald, R. H. Keefler, G. E. Lindsay (Manager), J. C. Harston (Captain), C. M. Wells.

WATER POLO.

By C. A. Harston, School Captain.

THE School Water Polo team went into the game this season with the intention of bringing the Eckhardt Cup back "home." The team did it, and went one better, going through the double schedule of the Intrefaculty Series without a defeat. There were no weak points in the team. With "Slim" Bell in goal, and Conklin and Schinbein on the defence, the opposing forwards stood but a poor chance of getting the ball into the net; this point is emphasized by the fact that only four goals were scored against the team during the whole season.

The forward line, consisting of Wells, Harston, Fitzgerald, Keefler and Matson (three at a time), were as hard to stop as the defence were hard to beat. The heaviest, hardest game of the season was played against an all-star team from the rest of the University, when the score stood 3-3 at the end of the regulation time.

The team played real water polo all year, and was the star attraction at Hart House tank during the series, as was evidenced by the crowded galleries of both sexes at all the games in which School played. All honor to them!

The first of the home-and-home games with McGill was held in Montreal. Our team, consisting of five School men, one Arts man, and two Dents, were held scoreless, while McGill netted two. This left us with a handicap of two goals to overcome on the return game here. For seventeen of the twenty minutes Varsity had the ball in McGill territory, but were unlucky with their shots. The final score of 1-0 gave McGill the round, 2-1. Varsity scored another goal, which was disallowed.

Rowing.

By Keith L. Carruthers.

Varsity is well out in front in rowing nowadays, and her eight-oared crews on which she specializes are found in "Who's Who" for Canada. All through the winter of '20-'21 the boys trained faithfully on the machines in Hart House under the able coaching of "Tommy" Loudon, of "School," and President Frank Spence and Captain "Les" McGee, of the Rowing Club. Need we state that these last two are School men also?

Early in April the old members renewed acquaintanceship with their shell, and the men who were new to the game had their first frightened look over the side of a working boat. The only race for three months was at the Dominion Day Regatta, when our tack-weight crew came second.

S.P.S. SWIMMING TEAM—Fitzgerald Cup Champions

Top Row—A. N. Conklin, C. G. Kingsmill, E. E. Schinbein, R. B. Kerr, C. A. Booth.
Bottom Row—J. C. Harston, R. H. Keefler, G. E. Lindsay (Manager), C. M. Wells (Captain). A. M. Fitzgerald.
Absent—M. D. Ross, G. C. Mutch.

The Canadian Henley, held four months after our crews took to the water, supplied the first races for the heavy crews. The first day our Junior crew, averaging 172 pounds per man, won easily over Argos, Detroit, Lachine and Hamilton. The tacks followed in second place in their race, Detroit leading them to the winning post. On the final day it was a grand sight to see our Senior and former Junior crews rowing one two for the Senior Championship of Canada and the retention of the Hanlan Memorial Trophy.

The rowing of the crews was so satisfactory that subscriptions were raised to take the Senior and Junior crews to the National Regatta at Buffalo. The first day the Junior crew rowed in the intermediate race, and the supremacy of Tommy Loudon's coaching was easily proved by a nice victory over New York A. C., Duluth, Detroit, Vespers, Nortons and Worcester. The final day both Varsity crews entered the Senior race. A terrific storm was beating in from Lake Erie at the time, but regardless of this the race started. The former Junior crew, profiting by their win of the day before, jumped at the gun and gained a length on the field. Unluckily a break in the breakwater let in enough waves to swamp partially their light boat, and they left the Seniors to battle it out. Though handicapped by the backwash found in an inside position, our Seniors came within two feet of the American Senior Championship.

The tack-weight crew consisted of Tufford, of Meds, and the remainder "School" men, namely, Johnson, McGee, Keefler, Williams, McQueen, Seaborne, Sirrs, Hamilton and Baxter.

The Seniors had Little, Smith, Bell, Huestis and Peterkin, of S. P. S., and Campbell, Coventry, Beatty and Creighton to help out. The Juniors had Carruthers and Smart, of S. P. S., plus Wallace, Jackson, Langford, Taylor, Malley, Morris and Croll.

The chances for this year are very bright. For a new Junior crew, fifty or so six-footers are turning out three times a week to pull the machines almost out of Hart House. The Senior crew will be picked from the best of last year's two crews. The club hopes to row somewhere this year, Parkdale C. C. being the place highest in favor at present. The building of a working boat is occupying most of the club members just now in the basement of the School of Science.

SWIMMING.

By R. H. Keefler, Varsity Captain.

THE past season has been undoubtedly the most successful yet experienced by the sterling swimmers from the Little Red Schoolhouse. After a term of strenuous training the S.P.S. team, for the third successive year, captured the honors in the Interfaculty Swimming Meet, thus retaining the Fitzgerald Cup.

The Interfaculty Meet was the closest in years. Curtis Wells won the 200 yards; Fitzgerald the 50 yard breast stroke; Keefler won the 100 yard sprint and came second in the 50 yard; Harston got third in the 100 yard race. Arts, with Ruddy and Waldron starring, kept pace, however, as far as points were concerned, and when the relay race was called, Arts led by 5 points.

As there were seven teams entered, two heats were necessary, the times taken to count. The School first team won the first heat handily with Arts in third place. Then our second team won the second heat in time good enough to give them fourth place. As first place gave eight points and fourth place one, while third meant three, the end of the meet found School leading 28-27.

At Montreal Varsity repeated their success of two years ago by winning the relay and, "incidentally," as a result, the meet, the other events being so close as to practically deadlock the rival teams. Wells won the 200 yard race; Keefler won two seconds in the 50 and 100 yard sprints; Fitzgerald came second in the 50 yard breast stroke, and three of the relay team were School men.

The following men took part in the various Interfaculty events for School: Wells III., Harston III., Booth I., Keefler II., Fitzgerald III., Conklin III., Schinbein III., Kingsmill II., Kerr II., Murray III., and Mutch III.

BOXING, WRESTLING AND FENCING, 1921-22.

By F. Seaborne, Secretary, B. F. & W. Club.

THE Faculty of Applied Science has, for the past three years, felt that the proper place for the Davidson Cup is within the walls of the "Old Red School."

We have the men,
We had the opportunity,

But—where is the cup?

The fault, I believe, lies with the two junior years. Senior men can not be expected to carry on for ever. True, there are a few who have found time to battle on even in their final year. They are the exception, not the rule.

We can not, halfheartedly, enter into competition with such worthy opponents of mitt and steel, as O.A.C. have proven themselves to be, and escape with the "tinware" unscathed.

In the Junior Meet this year, School was barely represented. Of the twelve School entries, seven were from the third year, leaving three entries from the first year and two from the second year. The total entry list from all faculties numbered 124. Had it not been for the efforts of W. S. Maguire, a third year miner, we would have had no one come through this meet undefeated. Maguire has trained consistently for the past three years and suc-

ceeded this year not only in winning the Junior 135 pound Boxing but entered and won the same class in the Senior Assault.

In the Senior Assault, we depended almost entirely upon a few "Old Reliables" and in spite of being poorly supported they carried School along, and though the "Aggies" are now polishing the Davidson Trophy the few men who represented S.P.S. may well be proud of their third place.

O. A. C. came down with a small army of boxers and wrestlers—two men in each weight—and demonstrated that the best way to get anything is to go after it, and that you cannot hope to win a class unless you enter it.

In the Senior Assault-At-Arms, Lavender—of the second year—carved his way to third place in the Fencing, and deserves great credit for so doing as all the fencing bouts are keenly contested and the first and second places went to Walton, Forestry, and Hewitt, U.C., who hold the Intercollegiate championship for '20-'21 and '21-'22.

In Wrestling, Harry Oaks, a fourth year man, battled two extra rounds before the bout was awarded to Adams of Dentistry. Adams holds the 135-pound Intercollegiate Wrestling for '20-'21 and '21-'22, but was unable to take a fall out of "our Harry." Oaks is an asset to any team and it is to be regretted that he leaves us this year.

In Boxing, Schemnitz, another fourth year man, won the 125 pound class in both the Senior Interfaculty and the Intercollegiate. "Shimmie" has worked hard and consistently for three years and all of us who know him rejoice at his success and wish we had a few more like him.

Maguire, who deserves great credit for his determination, succeeded in winning the 135 lb. Senior Interfaculty, but was later unplaced from the Intercollegiate team by "Goldie" Gray who is, unfortunately, a "Med."

We hope "Maggie" will be able to find time to turn out next year and we are confident that it will be no fault of his if he does not help bring another championship back to School.

Jack Goldie, the 175-pound terror, defended his title in both the Senior Interfaculty and Intercollegiate with marked success. We feared at one time that Jack would not be able to participate as he had injured his shoulder this past season, playing Rugby for Senior School. However his one-ton wallop proved as effective as ever and he remains at the top of the 175's.

These men have one and all devoted a great deal of their time to bringing honor to S.P.S., and those who remain with us next year are deserving of more support from their Toike Oike brotherhood. There once was a time when the School banner bore the time-honored motto: "Upguard et at 'em et soc et tu 'em," and it brought results.

BASKETBALL.

By Keith L. Carruthers.

BASKETBALL did not agree with Varsity this year, or vice versa, and we find the Intercollegiate laurels resting at McGill for the next twelve months. At the beginning of the season, the team toured the States both before and after Christmas. They did quite well, winning slightly over half their games, most of which were against strong University teams.

Following this, they gave a fine display in their home games against McGill and Queen's, winning both rather easily. Whether this gave them an impression that "all was right with the world" is hard to judge, but in the return games Queen's romped away from them at Kingston, and McGill nosed them out in the last minute at Montreal, giving McGill the title. Either Varsity eased up or the other teams showed a startling reversal of form from their Hart House efforts.

Senior School played fine Basketball in their group for the first three or four games, then they lost a close game to Victoria. This tied the group up, as both had beaten Senior Arts and Senior Dents twice. In the play-off, School were decidedly off color and took the short end of a 13-7 score. It was unfortunate that a slump appeared at a critical time.

In their group, however, the Junior School team came through in fine style, without a loss. At the moment of writing they are playing in the semi-finals with Junior Dents for the honor of representing their Faculty in the finals. In Turner, at centre, and Lloyd, on the forward line, the Junior School team have two great finds who ought to do themselves and School even more justice as time goes on.

Both of these players are on the Varsity Junior team, which has done very well this year, just being nosed out in the City League. On the Senior team we find only one School man, Duffil, who is one of the cleverest of guards and is certainly not the weakest man on the team.

Better luck next year, Varsity, and the same to you, Senior School gallants.

Gymnasium Work.

By M. H. Wolsey, Team Manager.

It seems characteristic of School men to have a good representation in every line of sport. They are not to be found lagging, even when it comes to gymnasium work. This line of activity usually has a very poor following on account of the slowness with which any advancement is made, and the fact that it takes a great deal of time and patience.

Of late years there have been quite a few gymnasts of note, but it remained with a small group of School and Medical men to form a University team. The outcome of this was an Intercollegiate competition last year, resulting in the team carrying off the honors on home ground. One-half of the team was composed of School men, namely, R. J. Williamson, S. Williams and M. Wolsey. These men do not include th emany School men who turned out regularly for the work.

All the School men taking up this work, assisted by D. Heustis, gave an exhibition number at the inaugural night of "Spasms," where they demonstrated the character of the work on the high bar. The act was received very favorably, and stimulated the "cause" around the University.

At the time of writing this article the team for this year's meet has not yet been chosen. But as more than three-quarters of those turning out are School men and our captain for the year is R. J. Williamson—well, every indication points to School having a great deal to say again this year.

It is the old School spirit, and it is up to those following to keep up the good work. It is a major sport; "T's" are granted for it, and the physical development derived from participation in gymn. work is most beneficial. It is a line of activity not to be despised, and worthy of School men, calling for good condition, self-control, nerve and strength of arm.

INDOOR BASEBALL.

By W. L. Yack, Manager Senior School Team.

SCHOOL seems to keep knocking at the door each year in this sport, new to Varsity, but so far we have been unlucky. Junior School met defeat rather early in their group, but in group C, three of the four teams were very evenly matched. Two years in succession, Senior School have tied up their group, only to lose out in the play-off.

This year they lost the first game in their group, only to put on a burst and tie it up. With one game to play each, Dents, School and Trinity tied for first place. It took five games for Senior Dents to eliminate Senior School. Dents won two, lost one, and tied two games. In spite of their defeat, Senior School had on their team the two best pitchers in the league in Mummery and Mutch. Mummery, who is probably the speedier of the two, lost a lot of his effectiveness by the introduction of the third strike rule. Our catcher was unable to hold him, though Doran played very well in trying circumstances. The standing of Group C at the time of writing, with School definitely eliminated, is:

Dents	won 6	lost 3
Trinity	won 6	lost 3
School	won 5	lost 4
Arts	won 1	lost 8

The Senior School team had the following members during the season: C. R. Mummery, G. Mutch, H. Westren, A. Fitzgerald, W. Fitzgerald, J. Doran, W. Benson, J. McAllister, A. A. Bell, and W. L. Yack.

TENNIS.

By E. M. Little, Vice-President Tennis Club.

THE Undergraduate Tennis Tournament was held in the early part of October on the excellent courts of the Toronto Tennis Club. There were approximately one hundred entries, and owing to the good weather and the splendid manner in which the tournament was handled, it was run off in record time. W. Guillet won the singles tournament while Scott, Larkin, Banbury and Ham also qualified for the team. In the challenge round, however, Ham was eliminated by Burrowes.

McGill, in a letter to the athletic directorate, intimated their desire to have the Intercollegiate tournament played during their big Centennial Celebration Week. Unfortunately, it was impossible, owing to the large number of entries, to complete the tournament and decide the team in time to comply with their wish. Queen's, however, were in a position to play at that date, but were defeated by McGill. The following week the Varsity team went to Montreal, but were defeated by McGill, Scott, of the Meds, being the only man to win points for Varsity.

McGill will quite possibly have a stronger team in the tournament next year than this, so all Tennis players are requested to enter the local tournament so that Varsity will be able to put the strongest possible team in the field. This especially applies to School men, who are conspicuous by their absence in the Tennis tournaments these days.

Squash.

By T. S. Glover.

This game is one in which the undergraduate body has but a passing interest, for obvious reasons. First, we have only three courts for the whole Varsity, which means that only six men can play each half-hour of the day. Now the budding Engineer is called upon by a stony-hearted Staff to toil from early morn to twilight, or more definitely, 5 p.m. At this hour the courts are most in demand, and since one is only allowed to book a court a day in advance, many are disappointed daily.

Then, too, the galleries accommodate only about ten spectators for each court, so that those who wish to lean over the

coping and hurl encouraging remarks at the almost naked combatants are not always able to gratify their desires.

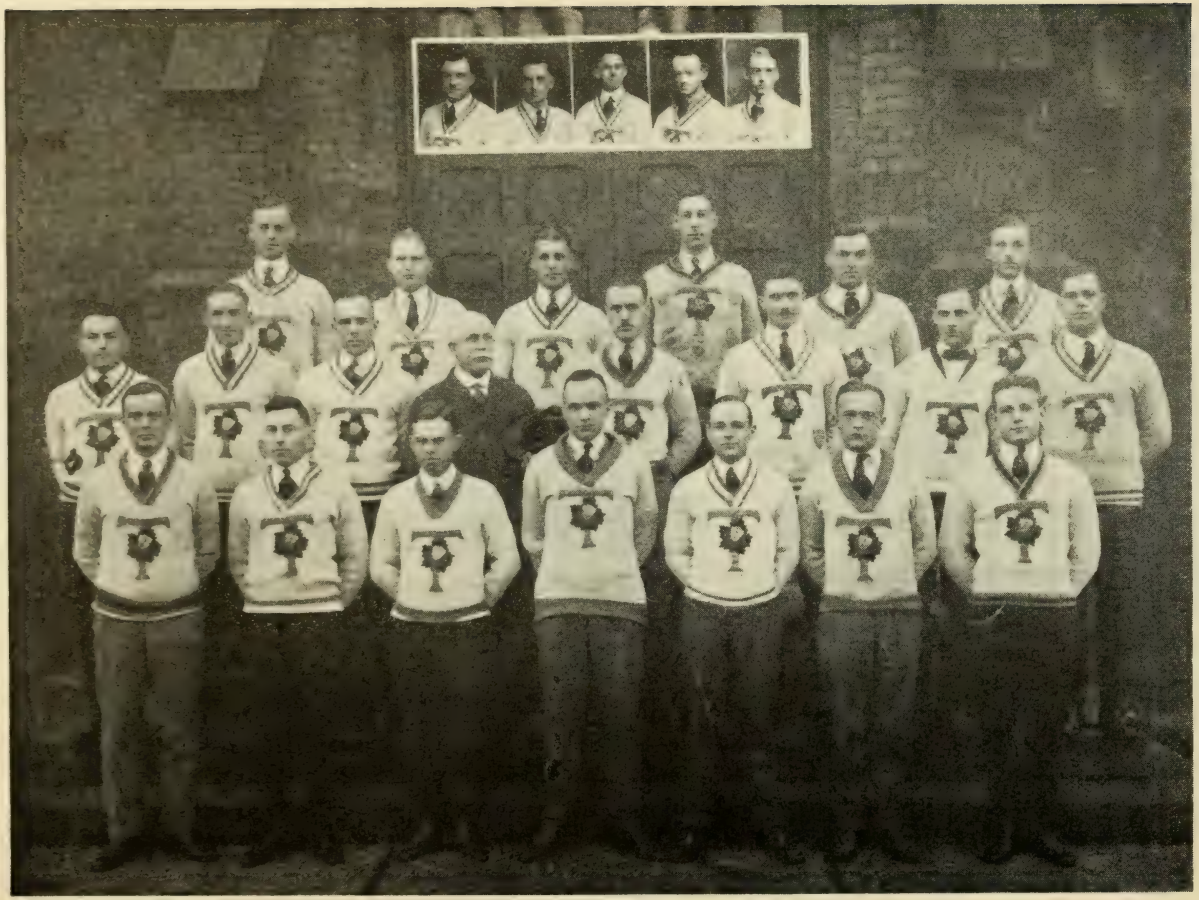
However, of the comparatively small number of men actively interested in the game, we supply a goodly number, of the usual School quality. Chief amongst these is Steve Greey, who has not yet succeeded in claiming the dizzy eminence of "top of the list," but in whose ability ultimately to do this we trust implicitly. It is only right and proper that this exalted position should be held by a School man. Hugh Lawson, one of last year's star turns, has unfortunately been laid up with a game leg, a present from Fritz.

It is encouraging to note that many newcomers have with a whoop and a yell descended on the courts—all as it should be. This is the only way in which we can secure the first twenty places on the tournament board, and we cannot be satisfied with less than that.

In a series of matches between the University Club and two Varsity teams of five men each, our opponents managed to beat us without undue effort—a condition of affairs we hope to see reversed before next season is over. We therefore exhort and encourage all true and loyal men to get into the game and work at it.

"T" HOLDERS OF S.P.S.

F. W. Baldwin, '06.....1903 R.
P. A. Laing, '05.....1903 R.
P. V. Jermyn, '04.....1903 R.
H. E. Beatty.....1903 R.
L. D. Young.....1903 R.
C. Johnson, '06.....1903 R.
M. B. Bonnell, '04.....1903 R.
W. C. Cochrane.....1903 R.
R. R. Bryce.....1903 R.
A. L. McLennan.....1903 R.
F. W. Burnham.....1906 R.
G. B. Reynolds.....1904 R.
W. R. Worthington, '04...1904 T.
E. W. Archibald.....1904 C.
W. Barber, '05.....1904 T.
C. Johnson, '06.....1905 R.
K. G. Ross, '06.....1905 R.
F. C. Broadfoot, '06.....1905 H.
F. F. Montague, '06.....1905 H., R.
C. G. Toms, '08.....1905 H.
W. C. Blackwood, '06.....1906 S.
J. M. McInnes.....1906 R.
H. C. Ritchie, '10.....1906 R.
H. Clarke.....1906 H.
K. Hall, '07.....1907 R.
M. E. Nasmith, '08.....1907 R.
C. W. Powers.....1907 R.
J. A. D. McCurdy, '07....1907 R.
E. W. Murray, '07.....1907 R.
M. Pequenat, '08.....1907 S.
W. H. Young, '05.....1907 S.
H. C. Davis, '09.....1907 T.
J. Van Nostrand, '09.....1907 T.
J. H. Adams, '10.....1907 T.
J. Newton, '09.....1907 R.
H. G. Kennedy, '08.....1907 R.
H. Gall, '10.....1907 R.
W. S. Coryell.....1907 R.
A. D. Huether, '08.....1907 R.
W. E. V. Shaw, '08.....1907 R.
L. A. Wright, '10.....1907 T.
G. E. Woodley, '10.....1907 T.
J. P. Charlebois.....1907 T.
J. I. McStoy, '10.....1907 T.
A. D. Campbell, '10.....1907 L.
C. A. Grassie, '08.....1907 S.
H. R. Carscallen, '08.....1908 S.
F. Y. McEachren.....1908 Ten.
C. P. Sills, '11.....1908 S.
G. A. Kingstone, '10.....1909 R.
A. E. Duncanson.....1909 R.
J. A. Macdonald, '10.....1909 R.
C. F. Elliot, '11.....1909 R.
A. W. Pae, '09.....1909 Box.
H. H. R. Macdonald.....1909 Box.
W. E. Doherty.....1909 Box.
A. M. McKenzie, '14.....1909 Sw.
C. Johnson, '09.....1909 Sw.



S.P.S.

T-HOLDERS

Top Row (L. to R.)

A. A. Bell
G. E. Lindsay
C. M. Wells
K. L. Carruthers
J. E. Goldie
S. Williams

Middle Row—

G. G. Duncan
W. H. Duffil
S. S. Smillie
Prof. C. H. C. Wright, R.A.
M. Wolsey
F. S. Seaborne
G. F. Evans
A. W. Carew

Bottom Row—

T. S. Glover
W. S. Sherk
R. J. Williamson
W. B. Ramsay
G. W. Smart
R. C. Relyea
J. C. Perry

Inserts—

F. C. A. Houston
M. F. Johnson
W. V. Bishop
M. G. Evans
E. G. Rolph

C. E. Gage, '18.....1909 R, B., Box.
R. B. Chandler, '11.....1907 T.
E. M. Watts.....1909 T.
J. M. Gibson, '10.....1909 T.
J. D. Cummings.....1909 Ten.
W. C. Foulds, '10.....1909 R.
W. H. Wylie, '11.....1910 S.
F. A. Lee.....1907 R.
C. E. Richardson, '10.....1910 H.
A. Code.....1910 H.
T. F. Lamb.....1910 S.
F. T. Nichol, '10.....1910 G.
G. R. Workman, '10.....1910 G.
M. M. Gibson, '10.....1911 Box.
R. F. Davison.....1911 Box.
R. S. Dobbin, '10.....1911 B.
I. R. Strome, '14.....1911 H.
J. J. Phillips, '13.....1911 T.
G. R. Elliot, '11.....1911 Har.
G. B. Taylor.....1911 R.
C. E. Macdonald, '18.....1911 R.
R. S. Bell, '13.....1911 R.
W. T. Curtis, '13.....1911 R.
A. M. German, '13.....1911 H, R.
R. Sinclair, '15.....1911 R.
E. Greene, '13.....1911 R.
H. D. Davison, '13.....1911 G.
P. S. G. Campbell.....1911 R.
D. A. McKenzie, '13.....1912 W.
D. A. Mutch, '13.....1912 Box.
W. B. Caldwell, '13.....1912 H.
H. Webster, '13.....1912 H.
F. F. Foote, '13.....1912 Sw.
L. B. Tillson, '15.....1912 Sw.
E. A. Twidale, '14.....1912 T.
N. H. Lorimer, '14.....1912 R.
L. R. Brown, '19.....1912 R.
D. B. Gardner, '16.....1912 R.
W. H. MacTavish, '13.....1913 S.
C. E. Sinclair, '14.....1913 H.
L. Simpson.....1913 B.
G. E. Clarkson, '13.....1913 H.
G. Rankin, '15.....1913 Box.
D. Blain, '13.....1913 G.
F. S. Rutherford, '14.....1913 P.
B. N. Simpson, '14.....1913 P.
M. Levy.....1913 Box.
K. C. Burness.....1913 T.
V. R. Pfrimmer.....1913 S.
G. Blackstock.....1913 R.
E. H. Jupp, '15.....1913 H.
J. P. Cavers.....1914 Box.
C. C. Anderson, '18.....1914 F.
H. M. Campbell, '14.....1914 F.
A. R. Mendizabal, '18.....1914 G.
R. T. Carlyle, '14.....1914 Sw.
R. H. Huestis, '20.....1914 G, Row.
F. Bryans.....1914 R.
W. O'Reilly.....1914 R.
C. A. Hughes, '20.....1914 R.
L. S. Adlard, '15.....1914 R.
S. M. Peterkin, '15.....1914 R, Row.
J. R. Gilley.....1914 S.
R. G. Scott, '15.....1914 S.
G. D. Gray, '15.....1914 S.
J. L. Skinner, '16.....1915 Har.
A. N. Burwash.....1915 Har.
C. E. Oliver, '16.....1915 F.
J. Gray, '15.....1915 W.
J. Ross, '15.....1915 W.
H. Kohl, '15.....1915 W.
E. R. Gilley, '20.....1917 B.
J. S. Wilson, '20.....1915 H.
E. R. Dafoe, '20.....1915 H.
C. Smythe, '20.....1915 H.
H. M. Peck, '15.....1915 Sw.
J. R. Mitchener.....1915 G.
G. R. Gouinlock, '21.....1915 H.
E. Birdsall, '20.....1915 R.
M. S. Taylor.....1915 R.
L. W. Ross.....1916 W.
W. J. Nichol, '20.....1916 H.
J. L. Levesque, '17.....1916 H.
E. W. Smithson, '17.....1917 R.
L. R. Shoebottom, '20.....1916 R.
H. S. Spencer, '21.....1917 Ten.
A. B. Harris, '17.....1916 R.
G. P. Pearson, '18.....1917 H.
D. G. Scott.....1917 H.
F. C. A. Houston, '22.....1918 R.
S. H. Johnston, '19.....1919 H.
W. B. McIntyre, '21.....1919 H.
W. B. Ramsay, '22.....1915 H.
K. L. Carruthers, '22.....1919 T, R., Row.
J. M. Breen, '21.....1920 R.
F. G. Sullivan.....1920 R, H.
G. G. Duncan, '23.....1920 R.
W. S. Sherk, '22.....1920 W.
J. C. Perry, '22.....1920 W.
O. D. Vaughn, '20.....1920 F.
F. S. Seaborne, '23.....1920 Box.
P. F. McIntyre, '21.....1920 H.
G. F. Evans, '23.....1920 H.
G. E. Lindsay, '23.....1920 Sw.
A. A. Bell, '23.....1920 Row.
J. D. Smith, '25.....1920 Row.
G. C. Bennett, '20.....1920 Row.
H. B. Little, '20.....1920 Row.
G. L. McGee, '21.....1920 Row.
J. B. Hamilton, '21.....1920 Row.
E. G. Rolph, '23.....1921 R.
M. D. Earle.....1921 R.
A. W. Carew, '23.....1921 R.
S. S. Smillie, '22.....1921 S.
S. Williams, '22.....1921 G.
M. H. H. Wolsey, '23.....1921 G.
R. J. Williamson, '22.....1921 G.
R. C. Relyea, '23.....1921 Box.
W. H. Duffill, '23.....1921 B.
J. E. Goldie, '23.....1921 Box.
C. M. Wells, '23.....1921 Sw.
W. Turner, '25.....1921 T.

M. G. Evans, '23.....1921 S.
T. S. Glover, '22.....1921 S.
W. F. Johnston, '23.....1921 S.
W. N. Bishop, '22.....1921 S.
H. E. Firth, '24.....1922 L.
W. E. Douglas, '98.....1922 Row.
T. Burnside, '98.....1922 Row.
R. H. Keefler, '24.....1922 Sw.
A. M. Fitzgerald, '23.....1922 Sw.
J. C. Harston, 23.....1922 Sw.

Total 190, or about one-third of all granted, arranged according to sequence of granting.

NOTE: R—Rugby; T—Track; C—Cricket; H—Hockey; S—Soccer; L—Lacrosse; Ten—Tennis; Box—Boxing; Sw—Swimming; G—Gymnastics; Har—Harrier; F—Fencing; P—Water Polo; Row—Rowing; W—Wrestling; B—Basketball.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY
TRADING ACCOUNT
For Twelve Months Ending March 31st, 1922

Sales		$16,764.29
Inventory, March 31st, 1921	$ 2,200.00	
Merchandise purchased	14,465.34	
	$16,665.34	
Less Merchandise on hand	2,450.00	
	$14,215.34	
Gross Profit to Profit and Loss Account	2,548.95	
	$16,764.29	$16,764.29

PROFIT AND LOSS ACCOUNT
For Twelve Months Ending March 31st, 1922

To Salaries	$ 780.00	
" General Expense	902.43	
" Alumni Re-Union	39.35	
" Spasms	757.75	
" Dinner	702.41	
" Orchestra	25.00	
" Dance	999.01	
" Grants to Affiliated Clubs	53.50	
		$4,259.45
Net Profit to Capital Account		2,278.22
		$6,537.67
By Gross Profit from Trading Account	$2,548.95	
" Fees	1,600.00	
" Sale of Caps	10.75	
" Interest and Discount	50.37	
" Spasms	669.60	
" Dinner	590.00	
" Dance	1,068.00	
		$6,537.67
		$6,537.67

UNIVERSITY OF TORONTO ENGINEERING SOCIETY
BALANCE SHEET
For Twelve Months Ending March 31st, 1922
ASSETS

Current		$7,694.91
Cash	$ 269.12	
Bank, Current	1,351.67	
Bank, Savings	2,500.00	
	$4,120.79	
Victory Bonds	1,000.00	

Accounts Receivable	$369.75		
Less—Reserve for Doubtful Debts	245.63		
		124.12	
Merchandise on hand		2,450.00	
		$7,694.91	
Fixed			634.29
Office Equipment	$624.29		
Less—Reserve for Depreciation	40.00		
		$584.29	
Smoking Room Furniture	$70.00		
Less—Reserve for Depreciation	20.00		
		50.00	
		$634.29	
			$8,329.20

LIABILITIES

Current			$1,245.25
Accounts Payable		$1,245.25	
		$1,245.25	
Deferred			120.28
Debating Club Trust	$ 8.90		
Suspense	23.36		
Publications	88.02		
		$120.28	
		$120.28	
Liability to Engineering Society			6,963.67
Capital Account	$4,685.45		
Net Profit from Profit and Loss	2,278.22		
		$6,963.67	
		$6,963.67	
			$8,329.20

A. ROSS GILCHRIST.
Accountant.

Expenditures to be Made During April, 1922

From Net Profit			$2,278.22
To Net Cost Publishing Transactions	$800.00		
Dividend to Members	922.00		
Ladies' Intercollegiate Hockey Cup	300.00		
Depreciation	50.00		
		$2,072.00	
Net Profit, April 30th, 1922		206.22	
		$2,278.22	
			$2,278.22

H. J. COULTER,
Treasurer.

ENGINEERING SOCIETY ELECTION RESULTS.
1922-23.

Engineering Society Executive.

President.....F. J. Lyle
First Vice-President.....C. A. Norris
Second Vice-President.....T. M. S. Kingston
Treasurer.....M. E. MacQuarrie
Secretary.....J. W. Kennedy
Curator.....W. R. Boake

Chairmen of Clubs.

Civil Club.....W. J. McLelland
Mining and Metallurgical Club.....W. S. Maguire
Electrical and Mechanical Club.....H. E. Wingfield
Chemical Club.....L. M. Price
Architectural Club.....A. S. Crawford
Debating Club.....A. V. Price

Athletic Association Executive.

President.....A. A. Bell
Vice-President.....J. G. Cade
Secretary-Treasurer.....K. V. Heyland

Year Presidents.

Fourth Year President.....R. G. Morrison
Third Year President.....W. J. W. Reid
Second Year President.....P. L. White

Year Athletic Representatives.

Fourth Year.....C. H. Lucas
Third Year.....R. H. Keefler
Second Year.....W. L. Thompson

School Y.M.C.A. Executive.

President.....J. C. Dumbrille
Vice-President.....J. Beattie
Secretary-Treasurer.....T. H. Jenkins

School Representatives on Hart House Committees.

House Committee—C. T. Carson, F. J. Lyle.
Library Committee—F. L. Lawton, W. L. Miller, V. N. Bruce, E. Cowan.
Hall Committee—A. W. McQueen, R. G. Morrison, F. W. Higgins.
Billiard Committee—W. T. Q. Bell, A. W. Carew, P. L. McVicker.
Music Committee—C. B. McQueen, N. S. Grant, G. K. Crowe, F. B. Boswell.

'22 Permanent Executive.

President.....H. G. Thompson
First Vice-President.....W. B. Ramsay
Second Vice-President.....D. L. Pratt
Secretary-Treasurer.....H. S. Weldon

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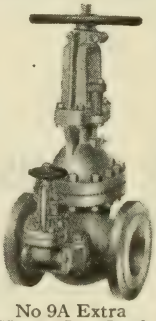

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